SOME DISEASES OF CATTLE IN INDIA

A HAND-BOOK FOR STOCK-OWNERS.

1927.

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PREFACE.

The last edition of this book was issued in 1916, with the following preface by Colonel G. K. Walker, C.I.E., O.B.E., F.R.C.V.S., I.V.S. (now retired) :—

Under the title of " A Manual of the more deadly forms of cattle disease in India " the late Colonel J. H. B. Hallen, C.I.E., the first Inspector General of the Indian Civil Veterinary Department, published in 1871 a popular hand-book for the use of cattle-owners. The book was revised by him in 1883 and again by the present writer in 1903. Under instructions from the Government of India the book has now been rewritten under the present title. I beg to acknowledge my indebtedness to my colleagues who have helped in preparing the lists of vernacular names of the various diseases.

G. K. WALKER, *Major*,
Indian Civil Veterinary Department.

POONA,
July, 1915.

The present edition has been revised by me at the request of the Agricultural Adviser to the Government of India. The advances in our knowledge of the diseases of animals and the interest now taken in livestock problems in India have demanded a complete redrafting of the text, with much extension. I have tried, however, to curtail the size of the book to the utmost limits commensurate with a fair presentation of the state of existing knowledge upon cattle disease, and, in this endeavour, have omitted undoubtedly much that might interest the reader. The desires of the reader will be considered in future editions if he will be so good as to point out the shortcomings of the book. A great physiologist (Bayliss) once said in the preface to an elementary treatise he wrote upon his life's pursuit that the most severe test of professional competence was the writing of a popular disquisition upon a technical subject. The reader may excuse what appear to him defective explanations in the text of the book in the light of this pronouncement upon the difficulty of the task which has been set here for me.*

J. T. EDWARDS, D.Sc. (Lond.), M.R.C.V.S.,
Director, Imperial Institute of Veterinary Research, Muktesar.

MUKTESAR,
P. O. Ritani,
February, 1927.

*The author wishes to record his appreciation of the assistance given to him, in revising the proofs of the new edition, by Major R. F. Stirling, F.R.C.V.S., D.V.S.M., F.Z.S., I.V.S., Officiating Pathologist, in furnishing him with certain valuable points of information upon field veterinary conditions in India, and Mr. S. K. Sen, B.A., B.Sc., Assistant Research Officer, of the Muktesar laboratory.

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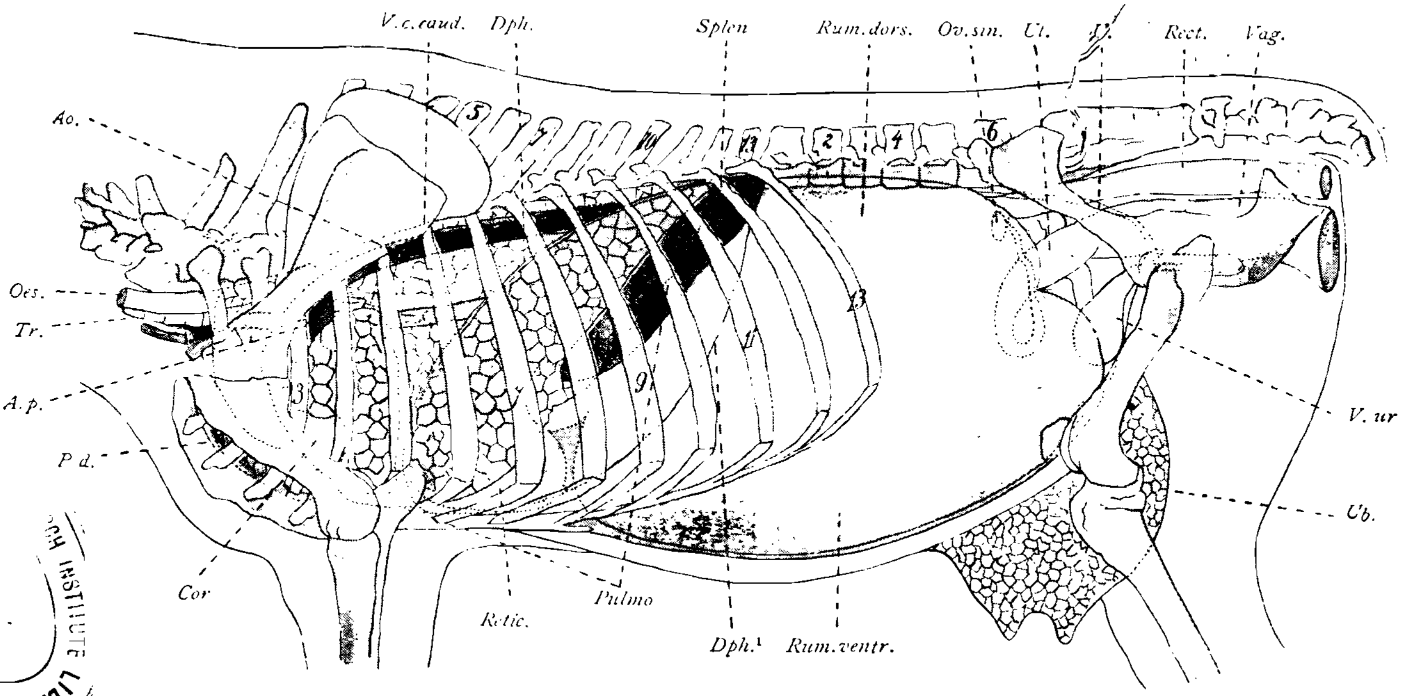

The Internal Organs of a Cow (Left Side).—*Ao.* Aorta; *A. p.* Pulmonary artery; *Cor* Heart; *V. c. caud.* Posterior vena cava; Tr. Trachea (windpipe); *Pulmo.* Borders of lung, with moderate inflation; *P. d.* Portion of apical lobe of right lung projecting into left side of chest; *Dph.* median portion and *Dph.*[1] costal attachment, of diaphragm; *Œs.* Œsophagus (gullet); *Splen* Spleen; *Retic.* Reticulum; *Rum. Dors.* dorsal, and *Rum. ventr.* ventral portions of Rumen; *Rect.* Rectum *Ov. sin.* left Ovary; *Ut.* Uterus (womb); *Vag.* Vagina; *Ub.* Udder; *U.* Ureter; *V. ur.* Urinary Bladder.

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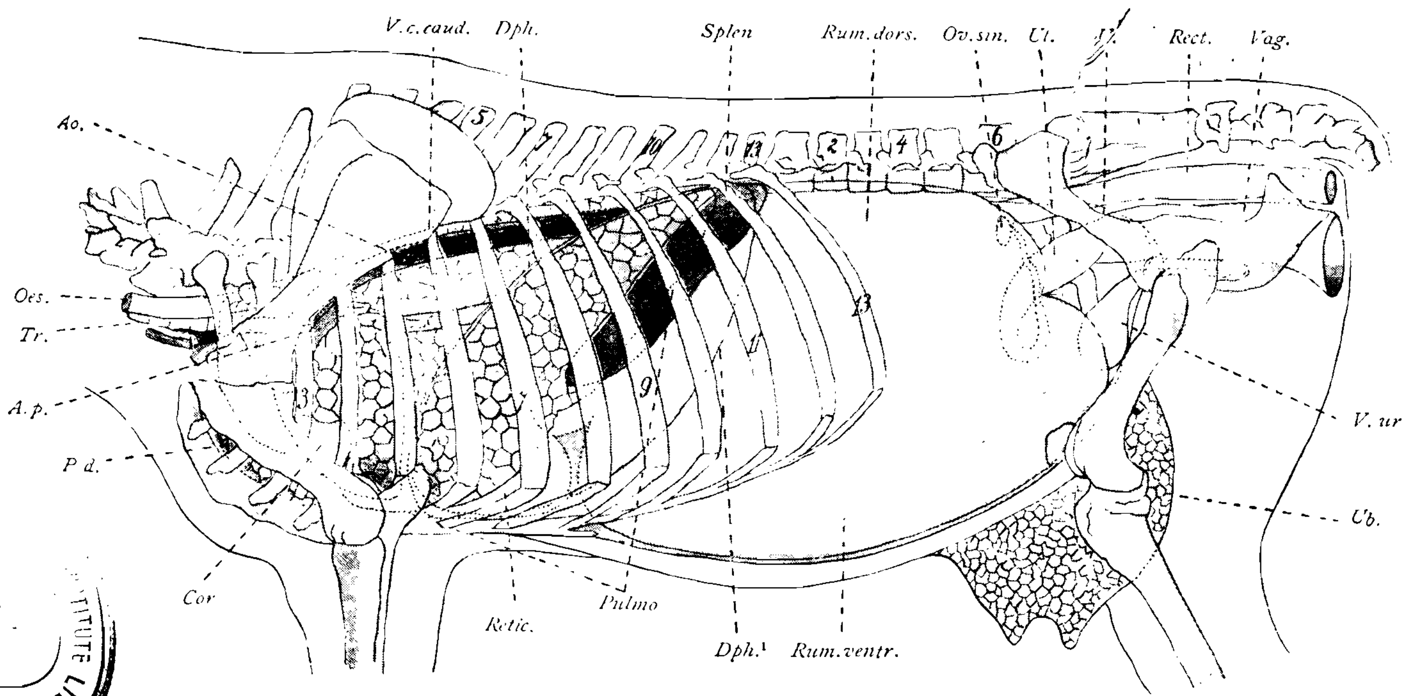

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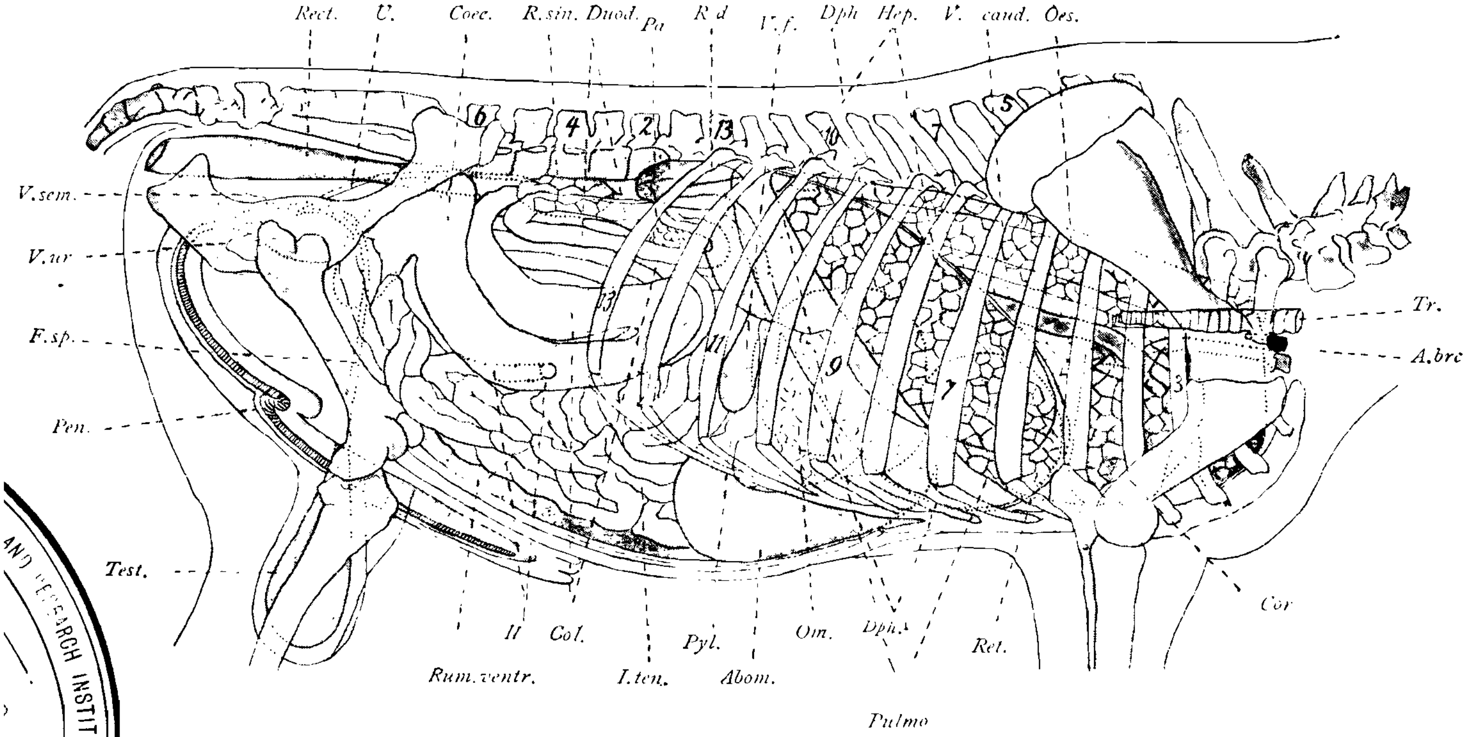

The Internal Organs of a Bull (*Right Side*).—*A. brc.* Brachial Artery; *Hep.* Liver; *V. f.* Gall-bladder; *Om.* Omasum; *Abom.* Abomasum (fourth stomach); *Pyl.* Pylorus; *Duod.* Duodenum; *Pa.* Pancreas; *Caec.* Cæcum; *Col.* Colon; *I. ten.* Small Intestine; *Rum. ventr.* ventral portion of Rumen; *Il.* Ileum (last portion of small intestine, with its insertion into the cæcum); *R. d.* right, and *R. sin.* left, Kidneys; *V. sem.* Seminal vesicles; *F. sp.* Spermatic cord; *Pen.* Penis; *Test.* Testicle. Other indications as for Plate I. (After Marek. Lehrbuch der Klinischen Diagnostik. 2nd Edn.)

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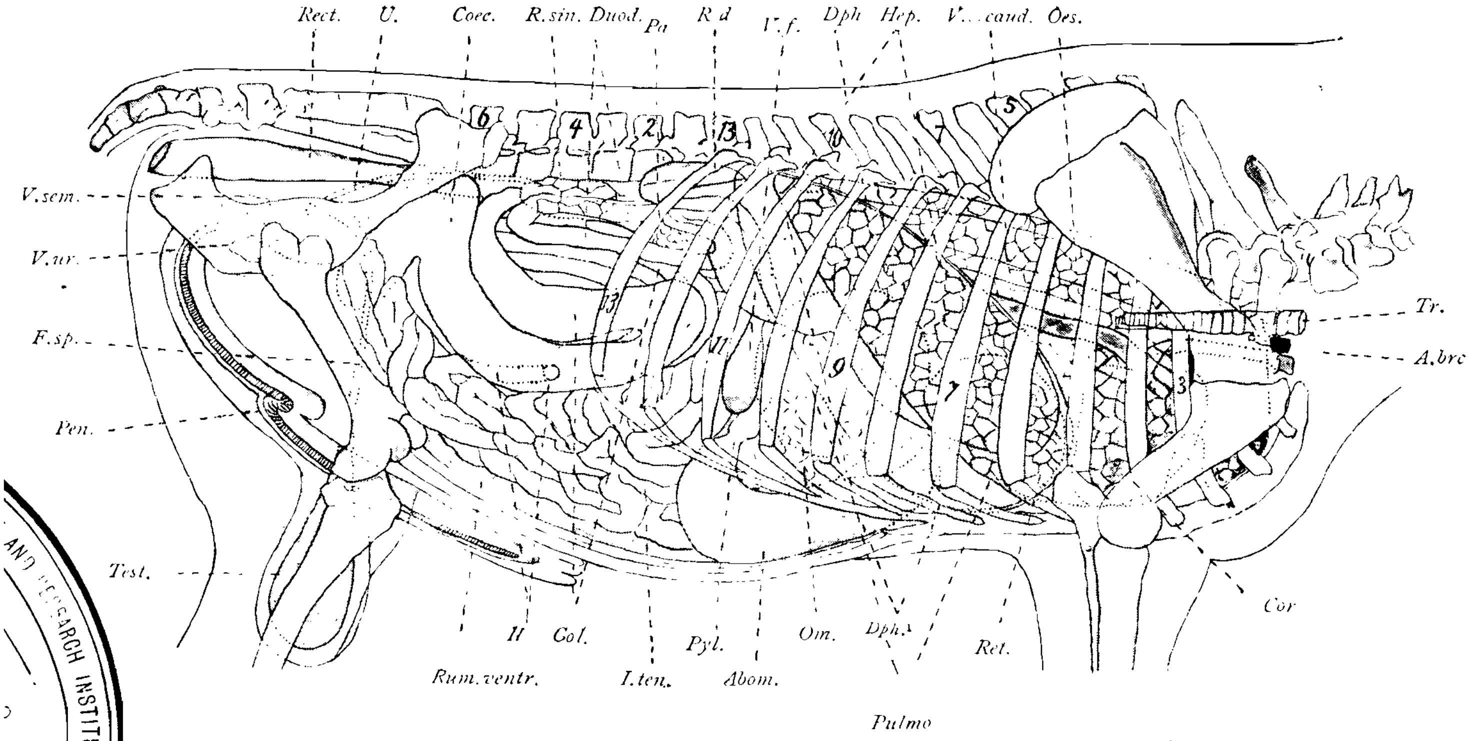
PLATE II.



The Internal Organs of a Bull (*Right Side*).—*A. brc.* Brachial Artery; *Hep.* Liver; *V. f.* Gall-bladder; *Om.* Omasum; *Abom.* Abomasum (fourth stomach); *Pyl.* Pylorus; *Duod.* Duodenum; *Pa.* Pancreas; *Caec.* Cæcum; *Col.* Colon; *I. ten.* Small Intestine; *Rum. ventr.* ventral portion of Rumen; *Il.* Ileum (last portion of small intestine, with its insertion into the cæcum); *R. d.* right, and *R. sin.* left, Kidneys; *V. sem.* Seminal vesicle; *F. sp.* Spermatic cord; *Pen.* Penis; *Test.* Testicle. Other indications as for Plate I. (After MAREK. Lehrbuch der Klinischen Diagnostik. 2nd Edn.)

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Some Diseases of Cattle in India.

CHAPTER I.

INTRODUCTION.

The aim of this small book is to tell cattle owners in India how to keep their animals in health, and how to deal with them when disease breaks out among them. It is not possible, within its compass, to do more than barely touch upon this big question : a proper understanding of health and disease in animals requires much skill and experience, and so owners are enjoined to call in the assistance of the veterinary services in India, which exist for this purpose, whenever they are in difficulty ; this book may help them, however, to do what is most needed pending the arrival of the veterinarian or when the desired professional aid is not forthcoming.

The experience of the cattle-owner will tell him when his animals are in good *health*, and, again, when any of them are suffering from *disease*—the opposite condition. Between these two extremes, of well-being and obvious *ailing*, he may notice that they are not thriving as well as they might be, and, if he wishes to get the best out of them, in work, milk, or other use, he ought to see to it very early that he has not neglected certain elementary precautions in maintenance. The losses from obvious disease in India are enormous, even staggering, when compared with those of other countries in which the most deadly cattle diseases are exterminated or kept down, with great pains and at much expense. The losses from unthriftiness, which do not strike so forcibly by the number of deaths, tell perhaps even more severely upon the pocket of the Indian owner.

How to maintain cattle in health.

(i) *Food*. Cattle, like all other animals, including man, require a certain quantity of food for maintenance, that is, for keeping the body alive even when it is in a state of rest ; they require a certain and very definite quantity more for production, that is, when the body is called upon to produce something extra, whether it be work or milk or fattening ; they require also certain essential additional nourishment during the period of growth. We know a great deal now about how much is required at each of these stages in the animal's life : for example, how much bulky food, such as grass, hay, straw, or *bhoosa* a cow must have

for her digestion to work normally, how much concentrated food, such as corn and cake, she should have for every *seer* of milk she yields, and what kind and quantity of food a calf and young animal must have unless its growth is to become stunted. Suffice it to say, that the most essential task for the owner who wishes to breed successfully is to provide his animals, at all seasons, with food, sufficient in quantity, wholesome in quality, and of the kind needed by the particular animals, bearing in mind their stage of development and the purposes for which they are employed.

It can be readily shown that the most productive animals, whether it be in milk or work, are far the most profitable to keep, and it is infinitely more economical to keep a few animals that yield well than a large number that each yield little ; productivity can only be attained by selective breeding, discriminating purchase, and steady elimination of low yielding animals.

The owner should likewise take pains to see that he is not likely to be overstocked, especially during seasons when his reserves of food-stuff may run short, and again he should take care to accumulate sufficient reserves for the stock he wants to keep during the seasons of natural shortage. Village co-operative societies would accomplish a very useful task if they formed to establish silo pits, for example, to lay up reserves of cattle food for anticipated periods of shortage, on the lines followed with success in some other countries. Bulls, the pedigrees of which are not known, and which are not likely to beget progeny with the highest qualities desirable and attainable, should be ruthlessly castrated. Proper feeding, it is felt, is something so essential in the well-being of cattle that it is necessary to impress it foremost upon the mind of the stock-owner in introducing him to the subject of disease. If owners find themselves in difficulties in providing proper fodder for their cattle they should seek the advice of the agricultural department in their Province.

(ii) *Water.* The importance of a pure water supply for human beings is now well understood : certain dread diseases, such as typhoid, cholera, and dysentery, are likely to be spread through a contaminated supply, and hence much money is spent by local authorities in water purification It is not necessary to pay this kind of attention to the water drunk by cattle, for we know that diseases of the same order are not conveyed to them by water. What is important is to see that they get it clean and in abundance. When cattle are housed or are not within continual access to water, they should be watered regularly twice a day, morning and evening—in hot weather, oftener. Each time, they should be allowed to drink their fill, undisturbed. The water should be clean, for dirty, puddled water is likely to cause indigestion, through the settling of earthy particles in the bowels. Stagnant water, and especially low-

lying, shallow, stagnant water, should be avoided, for it is a fruitful source of disease : worm parasites, the eggs of which have been dropped with the excreta of infected animals, find it their usual, most favourable medium for development, and afterwards they may be swallowed in large numbers by healthy animals, to set up in them unthriftiness of a kind most common in India. The germs of a very serious infectious disease, hæmorrhagic septicæmia, are believed to be taken up also in this way, with the advent of the monsoon. Anthrax sometimes spreads too in same manner Successful cattle rearing where the cattle are maintained mostly out of doors, therefore implies good agricultural husbandry, with effective drainage of pastures.

(iii) *Accommodation.* Diseases such as tuberculosis, that are spread after introduction among housed cattle, are now happily rare in India. This class of disease is the worst scourge of cattle in Western countries, where the animals are housed for a large part of their life-time. Tuberculosis is, however, by no means unknown in cattle in India, and there is now good evidence to show that the disease spreads just as rapidly as in the West when it makes its appearance among cattle maintained in just the same conditions. The chief, and perhaps the only important, reason why this disease is rare in India is because cattle are usually kept in the open air, for a large or for the entire part of their lives, and so the germs of the disease have little chance of massive propagation.

Where housing is provided for cattle in India, especially for the cows of private owners in towns, it is often very bad. It is true that a milch cow often seems to maintain life when the accommodation provided is very meagre, but the loss of vitality in the animal is exemplified by the losses caused by difficult parturition in large towns among the cows of wealthy owners who keep these animals for their domestic milk supply. Much might be written about the proper construction of cowsheds, but all that is required is said when it is stated that the accommodation should be ample, so that the animal can stand and repose in comfort, without risk of injury in any of its movements ; the drainage should be such that the animal is not soiled with its own excreta, and manure can be readily removed ; there should be no risk of injury to or from other cattle, and this is provided by the insertion of suitable strong ties and partitions ; the feeding trough or manger should be so arranged that the animal can be conveniently fed, without wastage of food ; and, the building should be sufficiently large and provided with adequate inlets and outlets for air so that the air inside always smells " fresh "— not too hot or too cold, or " fuggy," or " clammy."

The class of accommodation which cattle get when they are out of doors is of no less importance. It has been mentioned how certain diseases, notably worm diseases, can be spread on damp pastures. Overstocking on certain confined areas is likely to make the ground " cattle-

sick." This is caused by the voiding and repeated multiplication by passing through the closely kept cattle of various disease germs. The insidious, chronic diarrhœa and wasting of cattle called Johne's disease, now known to be very serious in some herds in India, becomes quickly spread in this way, and, in fact, most diseases are accelerated in their spread in the same way. On the other hand, some diseases are contracted and spread when cattle are kept on comparatively wild land; examples are "redwater" or "tick-fever," which is transmitted by certain ticks, that find conditions suitable for their development on shrubby, uncultivated land; the serious infectious disease known as blackquarter, which causes grave losses in many districts, especially after the commencement of the rains, arises from a germ found in certain patches of uncultivated soil. The cattle-owner ought, therefore, to plough up old standings from time to time, and bring under arable cultivation periodically, when it is possible to do so, land used by his cattle and known to be diseased.

Proper shade should be afforded to cattle to which they can retreat from extremes of direct heat from the sun, and shelter given from excessively cold winds.

(iv) *Injuries*. Gross injuries, such as wounds, yoke and other harness galls, bruises, sores, abscesses, fractures, sprains, are nearly always obvious to the owner by their appearance or effect, and yet often neglected until the time arrives when prolonged and expensive treatment is required, which might have been greatly curtailed if the injury had received proper simple treatment as soon as it was detected. Simple rules for dealing with injuries of this kind are to lay up the animal at once, especially if the injury is a harness gall or other injury likely to be aggravated at work; protect the sores from flies and dirt, with muslin or loose bandage if it can be applied, and wash them with a weak disinfectant or merely salt and water. If the injury is extensive, such as a wound that requires suturing, call for professional assistance. If there is fracture of an important bone, the hopes of recovery are very small, and the animal had better be destroyed. It is most important with open wounds and sores to prevent access of flies, and to wash out fly maggots from the wounds to prevent their extension. Ticks and biting flies cause much loss, and the means of dealing with them will be dealt with later. Snake bite is very difficult of effective treatment. Choking and a very common type of bowel injury in cattle caused by swallowing foreign bodies, such as pieces of wire or other hard sharp objects, will be dealt with in their proper place, as will also briefly the subject of poisoning, which again may be classed as a form of injury.

(v) *Infection*. To infect, means to taint, corrupt, or poison the body, with disease, and so denotes much the same thing as the infliction of an injury. The word infection has come to be used, however, in a somewhat

restricted sense when speaking of disease. We have seen that certain animals that are quite small but yet quite visible can injure the animal body, and thus set up disease ; such are ticks, flies and worm parasites of various kinds. It is now known that much smaller animals, such as the mange parasites, which can hardly be seen with the unaided eye can also set up disease : so also can animals so small (protozoa) that the eye cannot detect them without the aid of the highly magnifying lenses of a microscope ; minute parasites of this kind set up tick-fever (piroplasmosis) and surra. Minute living organisms (fungi, bacteria) belonging to the vegetable kingdom likewise cause innumerable diseases, (such as, hæmorrhagic septicæmia, anthrax, blackquarter) ; while some of the living germs that cause disease are so small that not even the most highly magnifying microscope can detect them with certainty. Diseases, of this kind caused by ultra-visible germs, are cattle plague (rinderpest), *foot-and-mouth disease, cow-pox and rabies, and yet we have* abundance of proof that these diseases are actually set up by multiplication in the body of minute living germs.

The term infection is now restricted to the invasion of the body by germs of this kind, which by multiplying within the body, or causing damage to important tissues, or by the action of their poisons produce disease.

It is well known to cattle-owners that certain diseases have a tendency to spread among animals ; some spread quickly, like cattle plague and foot-and-mouth disease ; some slowly, like tuberculosis, contagious abortion, and Johne's disease. The cause of the spread is a transmission of the disease germs, that is, infection, from the sick to the healthy, either by direct contact or through the medium of the excretions or exhalations of the sick animals. The term contagion is often applied to infection transmitted in this way. In some diseases, the infection is transmitted indirectly through the bites of flies or ticks from the diseased to the healthy animals, as in surra and tick-fever.

(vi) *Inflammation, fever, immunity, susceptibility.* These terms are often popularly misunderstood. When the living body is subjected to an injury, or infected, it does not remain inert, like a dead substance, but responds, more or less intensely and more or less successfully, until, on the one hand, it recovers, or the local injury is healed, or, on the other hand, it succumbs to the effects of the injury. The body may succumb rapidly as after an attack of cattle plague or anthrax or slowly as with tuberculosis ; or, it may tolerate the injury or infection for a long time, and its lifetime be inappreciably curtailed, as in infection with some worm parasites. The local response, seen, for example, when an abscess develops after the skin has been pierced accidently, is made manifest by a series of changes—heat, pain, swelling—and these changes are brought about by the endeavour of the tissues at the part, first, to prevent the

germs introduced when the wound was inflicted from spreading to the rest of the body, next to destroy the germs, and finally, by the growth of new tissue, to close up the wound. This response is called inflammation. When no germs are introduced, no abscess is formed, as with a sprained tendon, and the inflammation has for its effect merely the restoration to utility of the tendon by replacement of the torn tendon fibres with new tissue. Inflammation is therefore a beneficial process. When the germs of anthrax enter through the skin and a local swelling forms, there is a good chance of recovery ; when, on the other hand, they spread quickly to the rest of the body, without the appearance of a distinct local swelling, death almost invariably results.

The germs of certain diseases, taken in by the mouth, inhalation, or through the skin (as by the bites of ticks or flies) do not set up a local inflammation, but spread quickly throughout the body, and after a certain period during which they establish a foothold (the *period of incubation*) the animal commences to show general signs of disease, chief among which are fever (rise of temperature), loss of appetite, dullness, and other symptoms peculiar to the disease. During this stage the germs are multiplying very actively in the body, and the fever and other symptoms are an indication that the tissues of the animal in general (though we know certain of them come into play to a particularly vigorous degree) are exerting themselves to quell the multiplication of the parasites and to exterminate them or neutralise their poisons. A young, strong animal may thus be seen to respond to cattle plague with very high fever and subsequently recover, while an older, emaciated animal of the same class, may show only a small rise in temperature and afterwards succumb gradually to diarrhœ , and exhaustion.

When an animal has recovered from a disease it is often not possible for it to contract again the same disease ; in other words, it has become *immune*. This phenomenon of immunity is demonstrable in a very striking manner with some of the most serious contagious diseases of cattle in India. An animal that has once recovered from cattle plague is unlikely to get the disease again, and experiments carried out in the laboratory with this disease prove that the immunity remains solid for about two years and then gradually wanes.

The reverse of immunity may be termed *susceptibility*. We know that certain classes of animals are more susceptible to some diseases than others are, and that animals at certain ages are more susceptible to some diseases than they are at other stages of their life-time. The breeds of cattle on the plains of India are less susceptible to cattle plague than are hill cattle and much less susceptible than the cattle imported from Western countries, where the disease does not prevail ; we can explain this by assuming that the disease has prevailed on the plains of India since time immemorial, surging backwards and forwards in recurrent

waves, that have left alive each time in their retreat only the more resistant animals, and that the plains cattle of this day have been evolved, by a process of natural selection, from the more naturally immune animals of centuries. Indian cattle seem also to have a relatively high degree of natural immunity against anthrax. We have explained before that the rarity of tuberculosis among them is not attributable necessarily to a relatively high resistance, and it is certainly not brought about by a relatively low virulence of the disease germs existing in the country, but can be explained by the circumstances in which cattle are commonly kept, like sheep and goats in other countries. The same applies, to a very large extent, to contagious abortion.

Usually, very young animals are more susceptible to disease than older animals are. This applies to many bacterial diseases, such as nâvel-ill and white scour of calves, septic pneumonia; and affections caused by worm parasites (the so-called " husk " when certain worms invade the respiratory tract, verminous diarrhœa, and liver-fluke disease). Young cattle, from about three months to two years old, are the ones usually found affected with blackquarter.

On the other hand, we find, much more rarely, that young animals are less susceptible than old ones to certain diseases. The most striking example is that of tick-fever (" redwater ", piroplasmosis, or Texas fever) : calves after infection show little disturbance except a rise of temperature (fever), which may be very slight ; then as cattle get older when they are first attacked they become more and more susceptible, until after they have passed 18 months of age they show severe disturbances on infection, and often die. The animals are immune afterwards on recovery from the tick-fever, but nevertheless they harbour the causal germs in minute, suppressed numbers in their systems throughout their life-time, and may therefore act as " *carriers* " of the disease. Consequently, the disease can be transmitted from them by the bites of ticks to healthy animals in the vicinity. The immunity of these " carrier " animals is very solid, but there may be a breakdown in the immunity when they become infected with cattle plague. In most localities in India, it seems that cattle become infected very young, as calves, by the bites of ticks, with this disease, and grow up immune to it. When, however, an adult animal is introduced into their vicinity from a " clean " district, it is very likely to succumb before long to acute redwater ; this often happens with bulls imported from Europe for breeding purposes.

There is now good reason to believe that young adult cattle, under two years old, are more resistant to cattle plague than are adult cattle of the same class over three years old (the same difference has been shown to exist with foot-and-mouth disease). This difference in age susceptibility is a property of considerable interest to the stock owner, in

protecting his cattle against cattle plague, by the more permanent system of inoculation, known as the serum-simultaneous inoculation. His stock should be treated by this preventive method at regular intervals, (once yearly or, at longest, every two years) so that all cattle receive the initial inoculation as young adults, or calves, when they are less likely to be severely disturbed by the modified attack of rinderpest transmitted to them, or by the tick-fever germs, which almost inevitably accompany the rinderpest germs in the small quantity of blood used for the inoculation. (This complication need not now be feared, with the employment instead of the newly-discovered method of injecting "goat virus" in the serum-simultaneous inoculation.)

(vii) *Epizootic and enzootic diseases.* When in a herd one animal is affected with sickness, as when an animal has an acute attack of what is popularly called acute indigestion, the disease is said to be *sporadic* in its occurrence. We get the other extreme when a certain kind of disease spreads throughout the countryside without any tendency to stop in its spread whenever it encounters healthy cattle. Cattle plague and foot-and-mouth disease are notable examples of diseases that spread in this way. Diseases of this kind are called epizootic diseases, or simply, epizootics. On the other hand, we know of certain diseases that have a restricted or localised distribution: blackquarter is confined to certain areas of uncultivated ground; tick-fever to land covered with coarse, shrubby vegetation, favourable for the development of ticks; and, liver-fluke disease particularly to certain marshy districts. These localised diseases are termed enzootic diseases, or, simply, enzootics. Some enzootic diseases have also a marked seasonal distribution; hæmorrhagic septicæmia in most districts where it has tendency to occur annually in India appears after the commencement of the monsoon, though in the Punjab notably it may occur after the winter rains, or even throughout the year in the canal zones. These terms correspond with epidemics and endemics as applied to human diseases.

It is a curious observation that both epidemic and epizootic diseases do not prevail with regular, uniform intensity, or affect susceptible subjects throughout the country with uniform incidence, from year to year. In some years, cattle plague in India causes severe losses: the disease shows a tendency to rapid spread and the mortality rate in outbreaks is large. In other years, this disease is relatively much less alarming: outbreaks are few, the disease shows little tendency to spread, and the mortality in outbreaks is low. It seems that there is a regular alternation, of intensification lasting about three years, and abatement lasting about three years. It is not always easy to explain this so-called epizooticity of disease, but in the case of cattle plague it may be explained by assuming that after propagating progressively in a "soil" formed of healthy susceptible cattle for a period of years, the germs or "virus"

of the disease become exhausted in numbers, or attenuated in virulence, for want of susceptible, live soil, and the disease then survives in a checked or retarded manner, until the time arrives when the progeny of the survivors of the former period of exalted virulence constitute for it again an abundance of fertile soil.

(viii) *Treatment of disease.* It has been thought expedient to introduce in this manner the diseases of cattle, and their treatment, to convince the intelligent stock-owner :—

(*a*) That no real advance in this problem can be made without understanding the nature of disease ;

(*b*) That Nature herself provides most exquisite means of protection when once disease has become established, and that the most successful interference is that which modestly endeavours to aid Nature ; the whole galaxy of crude medicaments recommended for administration to sick animals are, at best, usually only palliatives, and a large number of them are actually harmful ; some, indeed, by relieving distressing symptoms, such as wisely applied purgatives or wound dressings, or by helping the animal in the fight of his own tissues against disease, such as stimulants given to the enfeebled animal, are really helpful. There are very few specific remedies, such as quinine is in human malaria : of this order are *trypanblau* in tick-fever, tartar emetic and " Bayer-205 " in surra, extract of male fern in fluke disease, copper sulphate and some other drugs for certain intestinal worms, and certain antiseptics applied to open wounds. It is important that the stock-owner should not be gulled into a sense of satisfaction by the exhibition of an imposing armoury of medicaments ;

(*c*) That often the only means, and always a necessary means, of aiding Nature is good nursing, the provision of clean, comfortable surroundings, protection from excessive heat or cold, and coaxing the animal's appetite, by the offer of tempting, digestible food, and sometimes forcible drenching, when this fails, with well prepared, soft, easily digestible, nourishing food ;

(*d*) That every means that are practicable and economical should be employed to prevent the introduction of diseases.

(ix) *Protective inoculation, vaccination.* It has been said that after recovery from certain diseases, cattle are immune for a long time towards further attack with the same disease. This statement applies to all diseases, but with some the immunity developed is much more pronounced than with others. After an attack of cow-pox or cattle plague, for example, the immunity is a very solid and durable one ; after an

attack of tuberculosis, from which the animal definitely recovers, there is scarcely any additional immunity, but, nevertheless, it can readily be proved that the animal body does respond slightly in the same way, for an animal that is suffering from very slight tuberculosis is highly resistant towards massive infection with this disease. Immunity towards reinfection is thus known to be very strong with many diseases caused by bacteria and the ultra-visible viruses. This knowledge enables us to devise a most powerful method of protecting animals and man against these diseases. It is the basis of the Jennerian method of vaccination of human beings against small-pox : in this method, the material used is calf lymph containing the living cow-pox virus (or vaccinia), which is a very near relative of the small-pox virus (or variola), but differs from it by setting up only a slight attack of disease in the treated human being ; after recovery, the human subject is strongly immune against infection with the much more virulent small-pox virus. This method has become the prototype of our modern methods of protecting animals or man in the same way, and hence the processes employed are generally called *vaccination*.

It is not always safe, or necessary, to employ the living germ of disease for use as the *vaccine*. In the vaccination of human beings against plague, typhoid, or cholera, the germs are grown in suitable artificial nutrient media, such as broth, in the laboratory, the cultures so obtained are killed by heat or disinfectants strong enough just to destroy the germs, and it is these dead cultures that are inoculated, or injected under the skin, for protection. The body responds to the presence of the dead germs in much the same manner as if the living germs of disease had found their way into it, but there is no danger. After the lapse of about ten days or so, the response has been sufficiently strong to enable the body to withstand, for a long time afterwards, a natural attack of disease, that is, invasion with the specific living germs. The process now employed on a large scale in India for the protection of cattle against hæmorrhagic septicæmia in districts where this disease shows a persistent tendency to recur year by year is to vaccinate them, shortly before the onset of the season during which the disease is most likely to occur, with a dead culture of the hæmorrhagic septicæmia germ—a germ that is closely related to that of human plague.

Again, it is sometimes found that immunity can be set up most conveniently and safely, not by the living germs or the dead germs but by the inoculation of the poisons, or toxins, secreted by the germs when they are grown in artificial culture. The older method of protecting cattle against blackquarter was to inject them with a powder or pillule, consisting of the dried diseased muscle of cattle dead of the disease and treated by heating so that it contained merely minimal numbers of the

spores (the resistant forms of the germs) of the disease. This method was sometimes risky, when the powder was insufficiently heated, or inefficacious, when it was overheated. The method now recommended is to inject cattle in dangerous areas with a different substance, prepared by passing the liquid in which the germs have been grown in the laboratory through an earthenware or porcelain filter, the pores of which are fine enough to hold back all the living bacteria. This germ-free filtrate contains in solution the poisons of the germs and certain other substances which are not poisonous in themselves but exercise upon the tissues an aggressive effect which enables the living germs introduced into the body in contact with them to establish a foothold. These peculiar substances are called *aggressins*, and hence the germ-free fluid employed for the vaccination is often called "blackquarter aggressin". The advantage of using this fluid is that it is always safe, more certain in its effects, and can be conveniently inoculated.

Cattle that recover from disease and are subsequently immune towards further attack develop this immunity in virtue of a change in the constitution of their tissues. Sometimes it is possible to demonstrate this change quite readily by a suitable examination of the body fluids. If we take an animal that has recently recovered from cattle plague, withdraw from it a small quantity of blood, and inject this blood under the skin of a beast that has never had the disease, we find that the animal injected in this way can withstand, at once and for a few days afterwards, exposure to infection without contracting any visible signs of the disease. Something has therefore been injected in the blood that either neutralises the effects of the disease germs when they enter the body of the healthy animal or enables the tissues of the animal to prevent the germs from exercising their lethal effects. This knowledge is of paramount importance, in furnishing us with a sure weapon for combating some of the most deadly cattle diseases in India, notably cattle plague and hæmorrhagic septicæmia. What is done in preparing the material for use against cattle plague is to subject cattle at the laboratory to a very mild attack of the disease; afterwards, blood is withdrawn from them at regular intervals for two or three months, and they emerge unscathed from the process. The clear liquid separated from the clotted or congealed blood is called the *serum*. The serum obtained at the laboratory from a buffalo treated in this way may be sufficient to protect a thousand other cattle in India against cattle plague, and enormous quantities are now distributed every year for use.

The process of preparing serum for use against hæmorrhagic septicæmia is quite similar in principle; it can be more readily prepared, by injecting the laboratory cattle with cultures of the disease germs that have lost their virulence by long cultivation, and the injections can be repeated from time to time so that animals may yield good serum almost

indefinitely. A protective serum is prepared in the same way against anthrax and blackquarter.

The great merit of a protective serum as compared with a vaccine is that an immunity can be set up by it immediately, while the immunity that follows after vaccination takes a few days to become established. In the face of actual outbreaks of disease, serum inoculation is therefore invaluable, for all animals that are exposed to danger and have not already contracted infection can be protected surely and at once. Serum inoculation has, however, one considerable disadvantage as compared with vaccination: its effects last only for a few days, and this is because the beneficial properties (the so-called antibodies) are gradually excreted. The animal's body has taken no *active* part in the elaboration of antibodies as it does after a natural attack of the disease or after vaccination, but is merely *passively* protected, by the transference to it of a small quantity of antibodies from an actively immune animal. Nevertheless, a large experience has shown that the serum protection when applied to all exposed animals can break up the chain of natural transmission of the disease so effectively that the outbreak stops dead; this phenomenon is seen very strikingly in outbreaks of hæmorrhagic septicæmia, and also, when proper standstill measures are adopted, with cattle plague.

Can the protection against cattle plague be made permanent? As this is the most serious cattle disease of India, the question is of the highest importance to the cattle-owner, for he naturally wishes to know whether his stock can be safeguarded against extermination by this ever imminent menace. A wise stock-owner will not be satisfied with a procedure that is efficacious only in the presence of the disease actually in his herd. He naturally desires to know whether there exists some method of protection that can make all his cattle safe always against the risk. If he has them inoculated with serum alone when the disease is not imminent, the immunity will have passed away most likely by the time the disease is actually in the neighbourhood. In considering this question we have to keep in mind that cattle which have recovered from the disease are immune—for a very long time afterwards—against further attack. If in the course of an outbreak all the healthy animals are injected with serum, many of those exposed to infection will contract the disease, but through the protective influence of the serum the attack of disease will be so mitigated or suppressed that it will be scarcely noticeable: yet these animals will be found to possess a most durable immunity afterwards towards further attack. It is therefore a very good thing to mix the animals while they are under the serum protection with those already affected so that they stand every chance of passing through a mild, suppressed attack of the actual disease. It has often been recommended as a sound policy to smear the nostrils

of the inoculated animals with the discharges from the affected animals. This policy does not, however, always succeed in its object, for the virus of the disease is not passed out freely in the discharges of animals when they have reached an advanced stage of the disease.

A sure method is to be found, fortunately, in the so-called serum-simultaneous, or serum-virus, method. The healthy cattle are inoculated when convenient to the owner with a dose of serum, sufficient in quantity to protect the animal with certainty against cattle plague. Simultaneously, a minute quantity of blood rich in the disease germs (the so-called virus, which is obtained from an animal infected in the laboratory) is injected under some other part of the skin. If it were not for the serum protection, the animals would get very severe disease, but with protection surely established they pass through such a mild attack that it would seldom be noticed, except by taking the animals' temperature with a thermometer. In this way, a solid, durable immunity can be set up. It is stated elsewhere that the herd should be treated so that all cattle come up for the inoculation as calves or young adults. Thenceforward, it is a wise plan, in the light of our present knowledge, to put them through the process every two or three years.

These protective measures require, obviously, for their execution trained professional assistance; they are described very briefly here merely to show to the cattle-owner the kind of help which can now be placed at his disposal in the present state of veterinary knowledge.

(x) *Principles of preventive medicine.* The principles of protecting cattle against infectious disease are embodied in the following simple directions :—

(*a*) Do not admit cattle into your herd from diseased premises. Breed your own stock as far as possible, but if you are bound to admit animals by purchase, or otherwise, enquire into the state of the herd from which they are obtained. Your enquiries should elicit information as to whether any of the serious contagious diseases exist on the premises, which usually will be fairly readily ascertained; and, more particularly, whether any of the more chronic contagious diseases exist there; for example, contagious abortion, and the infectious chronic diarrhœa known as Johne's disease, for these diseases are usually introduced in this way, and are most difficult—indeed, well-nigh impossible—to eradicate once they are introduced.

(*b*) If you are compelled to purchase cattle for admission into your herd in the open market or in fairs, without knowledge as to their origin, segregate them—that is, keep them well separated from your own stock for at least a fortnight after arrival. This will give time for disease to show itself, if they have picked up the germs of some of the most serious and rapidly spreading contagious diseases before arrival.

(*c*) Do not allow your cattle to mix with other cattle if you can help it. If you have to move them from one locality to another, avoid *serais* and camping grounds that have been occupied by other cattle, which may have soiled the ground with the germs of infectious disease. Also, avoid, if you can, using drinking troughs and pools from which other cattle habitually drink in passing along the route.

(*d*) Avoid the use of land for your cattle with a bad reputation for disease ; if it is your own, and it can be readily done, plough it up, and rest it from cattle for a year or two.

(*e*) Take note of the diseases that are prone to occur in your neighbourhood ; if they are of real consequence and can be prevented by inoculation, seek professional assistance and have your cattle protected in good time.

(*f*) Keep a sharp lookout for reports of contagious disease in your neighbourhood ; if you receive such reports increase your vigilance ; do not allow your cattle to stray among other cattle, and keep them if you can within an enclosure into which other cattle cannot gain admission ; do not allow people who may have been in contact with diseased animals to come near your cattle ; guard them now jealously until the danger has passed away in the neighbourhood. Send a report of your knowledge either to the local *patel* or *patwari ;* if they reside at a considerable distance away, then report direct to the nearest Veterinary Assistant Surgeon.

(*g*) If an animal dies suddenly on your premises, from some unknown cause, it may be merely accident, or poisoning, or some disease not likely to appear in your other animals ; however, the death may be caused by some serious infection, such as anthrax or hæmorrhagic septicæmia. If you have no proof to the contrary, look upon the dead animal as having died of infectious disease, and dispose of the carcase accordingly, for a serious outbreak may start from the body or excretions. Burn it, if you can. If you cannot, bury it deep, and cover the carcase with its own weight of quicklime if you can. This precaution is necessary more particularly to prevent digging up of the carcase by wild aimals or by *chamars*, for the hides ; if quicklime is not available, therefore, spoil the hide by slashing it with a knife after it has been lowered into the burying pit. Do not throw the carcase into a river or other water-course. Burn or bury all discharges and manure from the animal, and also any tackle or harness used upon it just before its death. If you cannot afford to burn these articles, pass a flame lightly over their surfaces, or steep them for a day or two in strong disinfectant. Treat in a similar way the stall or standing in which the animal has been kept. A most useful implement for disinfection in this way is a lighted torch or painter's lamp. A good disiniecting fluid is strong carbolic acid solution or phenyl solution.

The success of the disinfection will depend upon the thoroughness with which it is done. If the animal has died in the open, take up a layer of earth from where it has lain and burn or bury it with the carcase. Also, put up a fence round the area where it has lain so as to prevent other animals coming near the contaminated ground.

(*h*) The precautions laid down in the last paragraph are not those that apply to some of the most serious contagious diseases of India, such as cattle plague. You will be given timely warning of the appear ance of these diseases, by noticing at first perhaps one animal sick and soon afterwards more animals commence to sicken. Note as soon as you can whether the sickness is like cattle plague, and if you have any suspicion whatever that it is this disease, waste no time—your success or failure in stamping it out will depend upon the length of time that elapses before proper preventive treatment is applied—and get into touch with your local veterinary department, to have your healthy cattle inoculated with serum. (It is assumed that the cattle have not been inoculated previously by the serum-simultaneous method.)

(*i*) To prevent spread as much as you can when it is not possible to have the serum inoculated soon, the best advice is to bring everything to a *standstill*. In fact, it is recognised in other countries well advanced in applying measures for controlling animal disease that the enforcement of standstill measures over a certain area around the centre of infection is the most effective means of control, and their veterinary police organisations work vigorously to this end. On a large establishment, where large numbers of animals are kept, in scattered locations, keep them where they are ; try to prevent access, therefore, between one lot of animals and another, by movement of the animals or intercourse of their attendants. In other words, do not allow all the animals to congregate in a small area.

(*j*) It is often recommended that the sick animal or animals should be separated, and kept in a place apart, which may then be reserved as a hospital. This is a wise precaution, but in itself it is not sufficient to keep the disease in check. By the time some animals are showing obvious sickness, it is almost inevitable that they will have spread the disease, if it is a contagious disease, to several of the animals with which they have been in contact during the preceding days. There is no means of knowing how many and which animals are already infected in this way, or are soon going to spread disease among other animals. Hence, arises the great importance of bringing all movements of animals within and around the scene of an outbreak to a standstill. With cattle plague, this kind of measure is so important that in view of recent experience an eminent veterinary authority has said that the disease can be controlled and eradicated readily now in the countries of Western Europe by the enforcement of standstill measures alone. The question of

greatest importance to the stock-owner is not that dealing with the treatment of the sick animals, but how to stop the spread of the disease to the healthy animals. The germs of cattle plague perish quickly in the ground—in a day or two—and the real danger of spread is from animals that are carrying the disease in its early stages, or, perhaps, in a mild form.

(*k*) With foot-and-mouth disease, limitation of spread is much more difficult, for the germs of the disease seem somewhat more resistant and more readily carried—by indirect means, such as litter and attendants. The same general principles apply to the control of this disease, but the measures employed are not likely to succeed so well.

(*l*) Pay strict attention always to cleanliness in your herd; rid your animals of vermin and parasites; ticks, which may not only transmit disease, *but also sap the condition and stamina of your animals,* can be kept down quite readily by regular spraying or dipping every two or three weeks.

(*m*) The general measures of control here enumerated are by no means exhaustive, although they represent what are believed to be the most essential. Particular diseases require, to a large extent, the application of particular measures, and so the laying down of general rules is difficult, without becoming unduly prolix. Therefore, learn what you can about the most important particular diseases shortly described in this book, and ascertain the means of getting into touch quickly with your local veterinary authorities to help you out when you should find yourself in difficulty.

(*n*) The great benefits to be obtained from co-operative cattle insurance are worthy of close attention. Obtain information upon it by applying to your local Registrar of Co-operative Societies.

CHAPTER II.

CATTLE PLAGUE.

NAMES.—Rinderpest. Hind.—*Mata ; Bararog ; Seetla ; Murri ; Mok ; Goti ; Mahamari.*

Cattle plague is the most serious contagious disease of cattle, (including buffaloes) in India. Goats, sheep, camels, wild ruminants and swine are sometimes, but much less frequently, attacked ; it does not attack horses and men. It occurs in all parts of India. Cattle in some districts are more severely affected than in others. In hilly districts the death rate is generally very severe, and 90 to 100 per cent. of the affected animals may die. On the plains the average mortality is often from 40 to 50 per cent., but in some years it is much less. Imported European cattle, or cattle with an admixture of European blood, are even more susceptible than are hill cattle. Animals that have recovered are not attacked again. The disease is spread by the excretions, (the urine especially, and the dung and discharges) of affected animals. The infection is usually carried by the movements of the sick animals themselves, but sometimes and much more rarely, also by attendants, other animals, and articles that have been in contact with the sick animals ; it is also spread sometimes by hides taken recently from the dead animals and not properly disinfected or cured. The germ or virus of the disease is readily destroyed by heat, desiccation, putrefaction and disinfection. In the presence of direct sunlight it is usually dead well within 48 hours. The germ (which is an extremely minute, "ultra-visible" organism) is found in the blood and other tissues and in the excretions of diseased animals, especially during the early stages of the disease. Spread locally therefore usually takes place through the medium of food contaminated with the excretions, urine principally, of sick animals. The disease is spread at a distance, on the other hand, mainly by living animals, that are generally suffering from the disease in an early stage or from a mild attack of the disease ; it seems that animals that suffer from very mild forms of the disease may carry the germs of infection in their bodies for some time. As the virus is a very fragile one, the infection is not likely to be carried by water, except when animals drink from pools into which sick cattle have only just passed urine, or even by attendants or other intermediate means over considerable distances.

The period of incubation, that is, the period that elapses between infection and the appearance of symptoms, is from three to seven days.

Cattle, and more especially the other susceptible animals, may be affected so slightly that they do not show distinct symptoms; these animals are likely to act unsuspectingly as carriers of the disease.

SYMPTOMS. The first symptom is a rise in body temperature (fever) (103° to 105° F.), detected by the use of a thermometer. Then follow dullness, rough appearance of hair (staring coat), redness of the membranes of the eyes and mouth, partial loss of appetite and cessation of rumination and lactation; constipation is often noticeable, the dung being coated with slime. On the second or third day small blisters (or "vesicles") are seen in the mouth, under the tongue and inside the lips. Later, there is a thick discharge from the eyes and mouth; diarrhœa sets in, with a peculiarly offensive smell; the dung may be mixed with blood and slime. (This is due often to resuscitation in the activity of dormant parasites, known as coccidia, in the bowel.) The vesicles in the mouth burst, that is, become ulcerated, and fairly large raw patches are seen where several ulcers coalesce, but not so large as those commonly seen in foot-and-mouth disease. There may be seen eruptions on the skin, especially on the skin of the udder, but these are more rare symptoms. When diarrhœa sets in, the fever drops and there is great prostration and weakness; the animal lies down almost continuously, with its head turned towards its flank. Finally, the animal loses consciousness (becomes "comatose"), and dies on the seventh to the tenth day of the disease. This is the picture seen in a fairly acute type of the disease. In less severe cases, death may occur later, in two weeks or more, and in mild cases the symptoms are much less pronounced and the animal recovers. In rare cases, the anim l dies suddenly, before diarrhœa has set in. (This is often due to resuscitation of the dormant tick-fever, or "redwater," parasites in the body,—*see* Introduction.)

Post-mortem APPEARANCES. The body is found to be wasted; there is a sticky discharge from the mouth and eyes, and the buttocks and tail are soiled with liquid dung. The membranes of the mouth and throat show ulcers, or abrasions. The most marked changes are to be seen in the fourth or true stomach which is often found to be greatly inflamed and ulcerated, and particular attention should be paid to the condition of this organ at the *post-mortem* examination. The lining of the small intestines is also frequently much inflamed and ulcers may be found in it, but the changes are usually not nearly so severe as in the fourth stomach. Careful examination will reveal the presence of enlarged and inflamed glands covered with exudate. The large bowels are usually congested and the rectum presents a peculiar streaky appearance. The gall bladder is often much swollen, and its lining membrane inflamed and covered with erosions. The lungs are congested and emphysematous. The spleen and liver are usually normal

in appearance. Small blood extravasations may be found in the heart and kidneys.

TREATMENT. Medicinal treatment is almost useless, and is generally not recommended; astringent medicines may check the diarrhœa, but do not prolong the life of the animal. The best treatment is good nursing, by providing the animal with comfort, suitable warmth, and a tempting diet, to maintain its appetite. Before the onset of diarrhœa a mild aperient (1) (about one half of the full dose may be given, with some benefit) and stimulating medicines (3 and 4) will alleviate somewhat the prostration and weakness. Better than these is the administration of gruel made of well boiled ground rice or other flour, with a little linseed meal about every four hours. The medicines recommended may be given in the gruel, but the gruel is perhaps almost as beneficial when given alone. If the animal does not take the gruel of its own accord, it should be carefully drenched with it—about a quart at a time. Some workers in India administer carbolic acid, one to two drams, in gruel as a drench in the very early stages of the disease. Coarse food, such as inferior hay or tree loppings, should never be given to animals while they are suffering or recovering from this disease. Young green grass or other tender green food should be offered in very small quantities often. Salt, given in the gruel, is beneficial, or a lump of rock salt placed within reach for licking serves the same purpose. If the animal is shivering of cold, its body should be kept warm with clothing; it should be shaded from the sun, and, if indoors, the building should be kept well ventilated day and night. As a rule, the injection of serum, even in large quantities, does not promote recovery except when it is given in the earliest stages of the disease.

PREVENTION. This is by far the most important aspect of treatment. It has been dealt with at some length in the Introduction. It is now possible to protect all contact animals with anti-rinderpest serum. When the disease breaks out, professional assistance ought to be obtained with the utmost despatch to inoculate all the healthy contact animals. The protection of cattle in the scene of outbreaks by the inoculation of serum alone is now carried out on a large scale in India. The inoculation is quite harmless, and if the animals are done before they are infected, or very shortly after they are infected, no fever or other symptoms of cattle plague are seen. Cows in calf can be inoculated without fear of abortion; animals need not be kept from work. It has been said in the Introduction, however, that the best method of preventing spread is to bring the movement of all stock in the zone of infection to an absolute standstill, and they ought to be kept at a standstill for a fortnight after the last case of the disease has occurred. It is a wise plan, in fact, to keep the inoculated animals that have been near the infected animals

in close contact with these animals, for while they are under the influence of the serum protection they may then get the disease itself, but only in a very mild form, and become thereafter permanently immune. The immunity conferred by the serum alone does not last very long (about a fortnight or less), but it is immediate, and experience shows that it ought to be long enough to cut short the outbreak, if it is applied to all animals likely to have been in contact, directly or indirectly, with the diseased animals, and the movement of animals likely to have been infected is prohibited out of the suspected infected zone. The success of the inoculation depends very largely upon the inoculation of *all* animals in the suspected zone, so that no distributors of virulent infection, in the shape of uninoculated cattle that become in the meantime diseased, are left over to prolong the risk of infection until the time arrives when the protection conferred by the serum will have disappeared. For his own sake, therefore, the intelligent owner should endeavour to prevail upon all other owners of cattle in the vicinity of the outbreak to have their cattle also properly inoculated with serum.*

On the plains of India, serum-alone treatment has met with a degree of success in practice that has not been attained by it in some other countries: the greater success in India may be explained by the fact that the plains cattle are of relatively low susceptibility, and it is therefore easier to prevent intensive multiplication of the virus than in countries where the cattle are much more susceptible.

Disinfection measures are of second-rate importance in dealing with this disease, for, as has been said, the germ soon perishes in the outside world. Nevertheless, the cleaning and disinfection of standings occupied by diseased animals as well as all their accoutrements should not be neglected, as it is a measure calculated to destroy quickly massive local infection. Particular care should be taken to prevent spread through the raw hides taken from the diseased carcases. They should be steeped in strong lime and then exposed to the sun if it is thought economical, in spite of the risks, to utilise them. The owner of a herd in which the disease appears contracts a high moral responsibility towards his neighbour in carrying out all measures at his command to prevent the disease from escaping outside his own confines.

What has been said in the Introduction about the conference of a permanent immunity against this disease, by means of the serum-simultaneous inoculation, is now of first-rate importance to the owner of valuable stock. It is the only satisfactory solution, it would

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* It is unfortunate that the Hindi word *mata* is used to designate both human and cattle plague. An illiterate but devout Hindoo is said to consider that any attempts to limit rinderpest in cattle may cause the displeasure of the Goddess Kali who may then visit the home or village with human plague. "Better my bullock than my son" is said to be a common expression in the Maharashtra districts.

seem, to the question of protecting herds in India against the disease. It has been practised now on a widespread scale, with conspicuous success, by one of the most progressive States in India, and it has been employed for many years upon the most valuable dairy herds of the country. There seems no reason why it should not be practised universally, provided the owner consents and can afford to have it done, and the local authorities have in their employment the necessary trained professional veterinary staff. There is an appreciable risk, from complications caused by accidental introduction of the piroplasms (*Piroplasma bigeminum* and *Theileria mutans*), with imported cattle and the cattle of some rare localities in India; nevertheless, the method can be applied to indigenous cattle (for they nearly always already harbour these piroplasms) with almost negligible risk. With the rapidly increasing knowledge gained at the laboratory, it seems, however, that means have now been found of avoiding almost entirely these complications. Further particulars concerning the method can be obtained from the local veterinary authorities; a concisely worded circular, entitled "*The Active Immunisation of Cattle against Rinderpest, by the Serum-simultaneous method,*" describing the technical procedure, is issued from the Imperial Institute of Veterinary Research, Muktesar.

CHAPTER III.

HÆMORRHAGIC SEPTICÆMIA.

NAMES.—Buffalo disease; Malignant sore throat; Barbone. Hind.—*Galghotu ; Ghararira ; Gurka ; Ghotu ; Gargati.*

Next to cattle plague, this disease is the most serious infectious cattle disease in India. Hæmorrhagic septicæmia, as the name implies, is a disease in which the specific infection multiplies in the blood, and causes widespread local hæmorrhages, or escape of blood from the blood vessels, throughout the body. In cattle, these changes are very noticeable in the serous membranes (*i.e.*, the membranes lining the belly and chest) and, in natural cases, often around the throat, where they may be extensive and lead usually to a fatal termination; hence, the name malignant sore throat.

The infection is attributable to a minute bacterial organism, near relatives of which cause specific disease in other animals, including plague in man, fowl cholera, and rabbit septicæmia. The cattle disease, however, is peculiar to cattle, and is not transmitted to man and other animals although in other countries it is said also to affect sheep. In nature, buffaloes are much more frequently attacked than other cattle, probably through the partiality of the animals for moist surroundings, and so the disease has been also called "buffalo disease."

The disease is found in all parts of India, and more especially in low-lying marshy districts, and again it has a distinct tendency to break out in the wetter seasons of the year, that is, after the commencement of the monsoon, or, in some districts, with the Christmas rains. In irrigated districts, a few cases may occur throughout the year, but the numbers generally increase during the wet seasons.

It has been usually assumed that the germ exists in the soil in these districts, and gains access to the body, in some manner not yet properly understood, with the water-logging of the soil. Thereafter when the germ has once gained the ascendancy over the tissues of an animal, it gains tremendously in infective power (virulence), so that the germ passed out by the diseased animal may then readily gain a foothold in other cattle, with the result that several cases of the disease appear in quick succession with much the same appearance of spreading as that of a truly contagious disease. In the related disease of fowls (fowl cholera) and that of rabbits, we know that infection is transmitted in this way, by the ingestion of food contaminated with the excreta of diseased animals, but in the human disease (plague) it has been proved that the infection is transmitted by the

bites of certain fleas, which have taken it up from small animals (rats and some other rodents) that act as "reservoirs" or "carriers" of infection. It has been suggested, and it is not impossible that this may be true, that infection first establishes a foothold in the cattle disease in like manner, by the bites of insects or other skin parasites. Curiously, it is very difficult to transmit the disease by feeding cattle in the laboratory with doses of the germ artificially cultivated, but it is also known that the germ becomes somewhat rapidly degraded in virulence when grown in this way.

Animals that have recovered from the disease are generally immune for life, and this has been put forward to explain the observations that it is young animals that are chiefly affected in infected districts, and that usually only a portion of the animals are attacked when the disease breaks out in a village. The mortality in animals obviously affected is very high, estimated at from 75 to 90 per cent. The period of incubation is from one to three days.

SYMPTOMS. The disease may appear in an animal in several forms, but the usual symptoms seen in India are high fever (105 or 106° F.) and marked bodily disturbance, with difficult breathing; the visible membranes are intensely reddened, and there is dribbling of saliva from the mouth. A characteristic symptom very frequently observed in the field is a painful, hot, hard swelling of the throat and adjacent tissues. As a rule, the swelling is well defined and confined to the throat, but it may extend to the head and neck and sometimes to the fore limbs; the tongue in these cases is greatly swollen, purple in colour, and may protrude from the mouth. Breathing becomes more and more laboured as the disease progresses, and the animal dies from suffocation in from twelve to forty-eight hours after the first appearance of symptoms. Sometimes, death occurs in an hour or two after the animal has commenced ailing, or the animal may merely be found dead. Another form of the disease is a severe inflammation of the bowels, with abdominal pain, diarrhœa and dysentery (blood in the dung); this form may or may not be accompanied with throat symptoms. The disease may also attack the chest, in which event it runs a longer course and death takes place from pneumonia. The disease thus resembles anthrax to some extent in the rapidity with which death supervenes.

Post-mortem APPEARANCES. When the throat is affected the skin at that part is found to be thickened and the underlying tissues are infiltrated with a yellow, jelly-like fluid. The tongue is enormously swollen and purple patches are found in the throat. The windpipe and lungs contain froth, and the lungs are swollen. The lining membrane of the heart shows inflammatory patches. The blood is usually normal in appearance. The fourth stomach is nearly always

intensely inflamed, the mucous membrane being swollen and scarlet in colour. The bowels may be inflamed. The spleen and liver are usually normal in appearance but sometimes the liver and the kidneys are soft and readily broken down, or friable, to the touch.

TREATMENT. Medicinal treatment cannot be recommended, and, in fact, the disease usually runs its course so rapidly that treatment cannot be adopted. In India, it is a common practice to fire the swelling with a red hot iron, but this cannot be regarded otherwise than as a cruel and unnecessary procedure. If professional assistance can be obtained the operation of tracheotomy (cutting a hole in the windpipe) may be performed sometimes with advantage. In the milder cases, when there is no difficulty in drenching, an aperient (2) may be given, followed by stimulants (3) and (4) every four hours. Gruel is recommended to drink.

PREVENTION. In this disease, sick animals ought to be isolated at once, and the general measures for dealing with infective disease adopted; the dung, urine and blood of affected animals must be disposed of, by burial or burning. Carcases should be burnt or buried.

The reader is recommended to study the Introduction for what has been said generally about the origin of this kind of disease, and the consequent rational mode of prevention. Most important factors in prevention are the cleanliness and purity of the food and water supplies. The disease will be well known to the stock-owner to arise on certain pastures, especially those that are flooded, at certain seasons of the year. These known dangerous areas should be avoided, and, if possible, fenced off. Hay fodder, or other fodder stored in the open, should be stored on high ground, so that moisture, which may bring with it the infective discharges of diseased animals, does not reach it. Drainage from cattle stables and manure heaps often runs into village tanks, and it is probable that one of the chief reasons why the disease breaks out so frequently after a fall of rain is that the drinking water in the tanks becomes grossly polluted with contaminated droppings washed into the tanks. It should not be difficult to divert the drainage from the cattle standings so that it does not run into the drinking water. Buffaloes that have recently recovered from the disease should not be allowed to wallow in tanks used for watering cattle.

Serum Inoculation. A powerful serum is now prepared in the laboratory, for the protection of cattle exposed to danger in the actual scene of outbreaks. Large experience in India has fully proved its efficacy. As soon as the cattle owner suspects the occurrence of the disease in his herd or in his immediate vicinity, he should therefore summon immediately the aid of the local veterinary authorities, who, if the presence of the disease is confirmed, will arrange to inoculate all the healthy cattle with serum. The inoculation is quite safe, and it is observed often to

cut short the outbreak in a phenomenally rapid manner. Afterwards the disease very frequently does not recur during the season, but if after some weeks the disease does recur it can be stopped in its spread again by repeating the inoculation of serum.

Vaccination. This is also practised on a somewhat considerable scale now in India, notably in the Punjab, and the experience of several years has proved that it is a most invaluable method of protection. In the scene of actual outbreaks, it would be of limited utility, for it takes about ten days after the inoculation of the vaccine for an immunity against natural attack to be set up ; in this respect, it is therefore at a disadvantage as compared with serum inoculation. However, when once immunity has become established following upon vaccination, it lasts in a sufficiently powerful degree to ward off natural infection for several months—at least, for a period extending beyond the time covered by the season in which the disease is most likely to occur—and, subsequently, it is observed that the vaccinated animal has usually developed enough resistance, with advancing age or as the result of undergoing a mild natural attack, to require no further protection throughout its lifetime. In districts or localities where the disease is prone to occur year after year at a certain season, with distinct losses, the only certain means of protection is therefore to have the animals exposed to danger vaccinated a few weeks before the advent of the risky season. In irrigated or other districts where the disease makes its appearance throughout the year, it is a wise plan to have all young stock vaccinated at the beginning of the year, or when they are three to six months old. The vaccine is a dead culture of the disease germ, and the vaccination is perfectly safe.

CHAPTER IV.

ANTHRAX.

NAMES.—Charbon; Splenic fever. Hind.—*Garhi; Goli; Gilti.*

Anthrax, sometimes believed to be an uncommon disease in India, is much more prevalent than the official returns would indicate. Its importance is demonstrated by the known high incidence of infection in East Indian hides. Moreover, as the disease is usually sporadic in its occurrence, and but rarely gives rise to considerable outbreaks, it is inevitable that deaths caused by it pass most often undiagnosed; the carcases are then frequently skinned, and the infected hides constitute a common means of spreading the disease. It differs from the last two diseases described, in that cattle are not the only animals commonly attacked in India. Sheep, goats and horses are highly susceptible and often affected; it causes much loss also in some districts among elephants; camels not infrequently die of it; swine are more resistant but are also attacked; dogs are highly resistant, but outbreaks have been observed among packs of hounds taken over country strewn with infected carcases. Human beings become affected with it, very severely, usually when the infection penetrates a wound in the act of skinning a diseased carcase, and the acute local inflammation or boil that develops is known as "malignant pustule"; they may also become affected with fatal lung trouble in sorting the wool or hair taken from the skins of animals dead of the disease ("wool-sorters' disease"). At one time, before the disease described as hæmorrhagic septicæmia was properly understood, outbreaks of this disease were put down to anthrax. The two diseases are, however, quite different in their origin, but as the symptoms shown may be very similar, it is sometimes difficult to distinguish them without close examination.

Indian cattle, in the light of our present knowledge, show a higher resistance to anthrax than do European cattle; also, strains of the specific germ that causes the disease abound in the country differing greatly among themselves in virulence, so that, whereas in Europe the experience is that cattle once affected with anthrax almost invariably and rapidly succumb, in India the death rate is much lower and the germs of anthrax may be found in the blood of cattle that show mild fever only and then recover; cattle in India may also carry the germs for a long time in their systems before they succumb. Sheep in India are very highly susceptible to infection; goats are less susceptible, but the death rate in them in natural outbreaks is high, and skins taken from dead goats have been frequently reported to contain anthrax.

Anthrax is caused by a germ which multiplies rapidly within the blood vessels or in the inflamed tissues, and as illness lasts only a short time—often only a few hours—symptoms are often not observed and the affected animal is merely found dead. The finding of a beast suddenly

dead, from some unknown cause, should therefore lead to a suspicion of anthrax, and the only certain means of ascertaining the existence of the disease is examination of a minute quantity of blood taken from the carcase; this can only be done by a professional man, and what he does is to take a little blood from an ear vein for examination under the microscope for the presence of anthrax germs, which are usually seen in enormous numbers in blood taken from a fresh carcase.

Anthrax differs very much in its mode of spread from the contagious diseases already considered. Infection is always derived from a previously diseased animal, and, as will be readily understood, massive quantities of infection are voided on the ground when an infected carcase is skinned and blood allowed to escape; infection also escapes with the blood in the dung of the animal just before death and after death, for the carcase becomes blown up, or tympanitic, after death, and a blood-stained discharge escapes from the anus. At, or near, the temperature of the body, the germs in a few hours change into very resistant seeds, or "spores," and the vitality, or capacity for remaining alive, of the spores is so great that they have been found in the ground for periods *extending to thirteen years after the death of an animal from the* disease on the spot. The germs cannot sporulate, or form the resistant "spores" or "seeds", and soon perish, in the unopened carcase, for they require air for this process. The temperature in India is probably favourable for sporulation during a large part of the year, and also suitable sometimes for the growth of the germ and the development of new spores. (This probably accounts for the existence of multiple strains, of graded virulence.)

Healthy animals may therefore pick up infection in a place a long time after an *animal has died there from* the disease. It has been proved in India that grass cut from certain land upon which animals had died from anthrax several years previously set up the disease after feeding to healthy animals. Certain areas of land are known to be very dangerous, and hay or other fodder obtained from these areas are likely to give rise to anthrax. In particular, grass lands bordering upon water courses and flooded during the wet season have sometimes a bad reputation, and it is then found that this danger has arisen from the practice of throwing the carcases of dead animals into the water courses. In other countries somewhat similarly situated (South Africa, Argentina) the spread of anthrax in this manner is so serious that large outbreaks of the disease occur, and it has there become the most important cattle disease. The hides taken from diseased animals are very dangerous, and so are the bones, converted into bonemeal for manure, unless they are properly disinfected.

Cake and other feeding stuffs are frequently known to set up the disease in other countries, and the manner in which these foodstuffs

become contaminated usually is by shipment in contact with infected hides or wool.

The mortality among animals affected with anthrax is very high; in India, it has been said that it is probably a good deal lower in cattle than in Europe, but nevertheless in animals that develop distinct symptoms it is probably between 80 and 100 per cent. The period of incubation is usually short, from two to three days.

SYMPTOMS. The course of the disease is generally rapid; in fact, the affected animal is often merely seen dead, but if it had been possible to observe it from the commencement of its illness, the following symptoms would be seen:—High fever (106° or 107° F.) with severe congestion of the visible membranes of the eyes and mouth; abdominal pain, with evacuation of fluid dung, often blood-stained; urine sometimes blood-stained also; swellings may appear on different parts of the body, especially in cases that last somewhat longer, and they are generally diffuse and not painful or hot, as are the swellings seen in hæmorrhagic septicæmia; sometimes great excitement, followed by stupor; breathing difficult; the animal finally staggers, falls and dies in convulsions. (The symptoms are similar in sheep and goats, but in horses and swine they last longer, and swellings around the throat are often seen.)

Post-mortem APPEARANCES. Carcase usually much swollen, and putrefaction sets in early, resulting in a very disagreeable odour from the carcase an hour or so after death. A gelatinous exudate is generally to be found under the skin, particularly in the neck and where there are any swellings. Blood dark-coloured, "tarry," and thick. Muscles flabby, and spotted with blood extravasations. Internal organs congested and contain blood spots. Connective tissues mostly infiltrated with gelatinous exudate. Lungs engorged with blood, and trachea and bronchi contain a frothy blood-stained discharge. Spleen almost invariably greatly enlarged, much softer than normal, and may be ruptured. (The state of the spleen is very characteristic; hence, the name "splenic fever.")

TREATMENT. Medicinal treatment is ineffectual. (Anti-anthrax serum, if available, given in large doses, is of much value when given at a very early stage of the disease; it is not likely that opportunities for doing this will be afforded in affected cattle, but it is known to be an effectual proceeding for the treatment of men suffering from "malignant pustule.")

PREVENTION. Carcases of animals dead of anthrax, or suspected to be dead of anthrax, should not be skinned or opened on any account whatsoever. The local veterinary authority ought to be summoned with all possible speed to make a diagnosis on suspicion that death has occurred from anthrax, and to give professional directions for limiting

the spread of the disease if the presence of anthrax is confirmed. Pending the arrival of the veterinarian, the owner should protect the carcase from interference by other animals or human beings. Otherwise, if a veterinary authority is not readily accessible, the owner should arrange to dispose of the carcase forthwith, for the most important undertaking in preventing the spread of anthrax is prompt disposal of carcases: the carcases ought to be burnt (the weight of fuel required is about equal to that of the carcase); or buried, at a depth of at least six feet from the surface of the soil, and it is advisable to cover the carcase with quick-lime (its own weight), especially to prevent digging up by wild animals and *chamars*. All discharges, manure, and accoutrements from the animal should be burnt or buried at the same time, and a layer of soil, about six inches in depth, soiled by the dead animal thrown in likewise. The flame of a torch or painter's lamp should be used liberally on the surfaces of stable walls, partitions, vehicles, and any other objects likely to have been soiled with the discharges of the dead animal. A most dangerous proceeding is to throw the carcase, or incompletely burnt carcase, or any portion of the carcase into water courses. Care should be taken to prevent access of dogs, wild animals, or human beings before the carcase has thus been properly rendered harmless. It is a wise plan to erect a fence around the spot where the animal has died, to prevent access of other animals to the contaminated area.

Anthrax does not appear very often in the form of large outbreaks in India: it usually occurs sporadically: that is, in an infected locality a single case first appears, and subsequently a few cases may appear from time to time, so that it does not assume the characteristics of a highly infectious or contagious disease. It is not worth while, in these circumstances, to take in hand measures for the protection of the healthy cattle, when the imminent risk of anthrax is a very small one. We have knowledge, however, of certain localities where the cattle do run a continual risk from infection, sufficiently serious to warrant economically the adoption of measures to defend them against this risk.

Serum inoculation. A useful serum is now prepared for employment by the veterinary authorities in the inoculation of all healthy cattle in herds or villages where anthrax has been diagnosed and has shown a tendency to spread rapidly, by attacking a number of animals in quick succession. The immunity conferred by the serum is a short-lived one, but seems to be efficacious in bringing about what is expected of it.

Vaccination. The vaccine commonly employed is composed of the living anthrax germs much degraded in virulence by cultivation, so that a dose on injection will hardly kill a bigger animal than a mouse, but after inoculation into cattle will provoke them to react so that they develop an immunity lasting for about a year. It is now usually distributed in a convenient and reliable form, known as a "spore-vaccine".

This has been tried in some places in India to protect cattle in districts where there is a persistent recurrence of anthrax. There is no reason why its use should not be adopted confidently on a much larger scale where similar risks are run ; for, vaccination against anthrax is the oldest form of rational protection of cattle against disease, and it is very widely used in several other countries. The vaccine should, in any event, be one that has been well tested by a veterinary authority as to its safety before use.

CHAPTER V.

BLACKQUARTER.

NAMES.—Blackleg ; Quarter-ill. Hind.—*Ektraqia Goli ; Sujwa Garhi ; Zahrbâd.*

Blackquarter, or quarter-ill, as the name implies, is a disease that affects the large muscle quarters, usually one of the hind quarters, of cattle (including buffaloes). Sheep are also attacked, and goats and camels have been alleged to contract, rarely, the disease. Human beings suffer from a similar condition, known as "gas-gangrene," as a complication of wound infection. Our knowledge of the cattle disease has advanced a good deal following upon the studies of "gas-gangrene" made during the war. It affects particularly young cattle, between three or four months old (that is, from the time they commence grazing) and two years old; cases may be seen not infrequently at a later age also, but we now know that these odd cases are often caused by a type of germ a little different from that which causes the outbreaks in the younger animals, and they occur not uncommonly as a sequel to wound infection. Older cattle, however, generally possess a high degree of natural immunity. Outbreaks of blackquarter prevail at certain definite seasons of the year, usually with the commencement of the rains, when the ground has a tendency to become waterlogged. The disease also shows a distinct tendency to appear on certain restricted areas, always uncultivated land, and generally low-lying, swampy places with a rank vegetation. The infective germ exists in the soil of these areas, and is a highly resistant organism, for it is capable of sporulation and retaining its vitality for several years. We are not yet clear how the young animals become infected with the germ from the soil, for there are generally no discoverable wounds on the animals through which it could penetrate, and it is almost impossible to infect an animal by feeding it with large quantities of the germ by the mouth. A very serious form of a similar disease ("black disease") that occurs in sheep in Australia has been shown to be carried into the system by the common liver fluke in the course of its migrations, and it is not improbable that the tissue migrations of parasites, harmless or otherwise, particularly active at the time of the seasonal occurrence of blackquarter, may carry in their train from infected soil the virulent germs of this disease.

The mortality from the disease is so high that it may be declared that once symptoms appear the termination is almost invariably fatal. The very rare animals that recover are subsequently immune from further attack, apparently for life.

The period of incubation is about two to four days.

SYMPTOMS. The course of the disease is so rapid that often the affected animal is discovered dead without having shown noticeable symptoms. However, if one happens to see a case from the commencement, the course of symptoms is as follows :—The animal appears dull and stands apart from the others ; if it tries to move, or if made to move, it is noticed to be distinctly stiff or lame ; on closer inspection, a swelling will be noticed generally in one of the large muscle quarters ; in India, this swelling is very commonly seen to commence around one of the elbows, spreading afterwards to the shoulder and around the neck ; it may also be seen frequently in one hindquarter and, sometimes, both hind quarters, or, more rarely still, in some other muscular part of the body ; the swelling increases greatly in size in a few hours, and is particularly noticeable when it affects the upper parts of the thighs, the buttocks, loins, chest, or shoulder. Very rarely, it affects the mouth or throat, and is very prominent in these parts. At first, the swelling is hot and painful. Later, after it has increased in size, it becomes colder and less painful, and the animal at this stage is unable to move. It crackles, or crepitates, on pressure, through the formation of gases in the diseased muscle. The skin becomes cold or insensitive, dry in parts, and in others moist ; the hair over the moist parts readily falls away, and the moisture underneath emits a peculiar sour, rancid odour like that of bad *ghee*. The animal now lies down in great distress ; respiration becomes difficult ; the animal is unable to rise, loses consciousness, and dies.

Post-mortem APPEARANCES. If one cuts through the skin covering the swelling, thin dark liquid and gases with a very pronounced rancid odour escape. The muscles towards the centre of the swelling are greatly changed : dark, often quite black, in colour, friable, and permeated with irregular spaces caused by the gaseous fermentation, and around this most intensely affected part the muscles are darkened and excessively juicy. The connective tissue under the skin is often blown up with gas. The fermentation and discoloration is usually most marked in cases which have lasted longest ; often in animals that succumb rapidly it is not very intense. The internal organs show no striking change. Decomposition sets in rapidly in the carcase. Diagnosis of blackquarter should be very easy, from the appearance and peculiar odour of the swelling.

TREATMENT. No treatment is of any avail, once symptoms appear. Large doses of serum are certainly curative when administered quite early in the course of the disease, but recourse to this kind of treatment in the field is quite impracticable.

PREVENTION. Here, the rules prescribed for dealing with infective disease, so far as segregation or movements of animals are concerned,

are of very little utility. The carcases of dead animals should be properly buried or burnt, to dispose of large number of resistant spores that may be liberated otherwise from the dead animal. There is no danger to man from handling the carcases, which should be properly burned or buried to limit the contamination of the ground. Cultivation of known infected pastures is certainly recommended, where these pastures are capable of ready cultivation, but it is most likely that this procedure is for many reasons impracticable. The procedure recommended for adoption always in localities where this disease exacts a regular, serious toll upon the cattle is vaccination.

Vaccination. This has been practised throughout the world for many years, and has proved a great boon to livestock. The principles of vaccination have been explained in the Introduction. There are two kinds of vaccine available : (i) the old powder or pillule form, very efficacious when properly made, but sometimes dangerous, and not infrequently quite inefficacious when steps have been taken (as has been proved with many samples sold in the open market) to make it quite safe ; (ii) the new liquid vaccine (the so-called "germ-free filtrate" or "aggressin"), quite safe, and efficacious. Application should be made to the local veterinary authority for the administration of the vaccine. (A printed circular upon the modern system of vaccination is issued from the Imperial Institute of Veterinary Research, Muktesar, to the authorities, on request.) The vaccination should be performed a few weeks (usually during the month of May) before the commencement of the season when the disease is likely to break out, as it takes a week or two after the injection for immunity to become established. The immunity lasts several months (four or five, and perhaps longer) which is sufficient to tide the animal over the enzootic season, and thereafter its own natural immunity with advancing age is generally sufficient to ward off attack in subsequent years.

Serum Inoculation. A good serum is also now made in the laboratory for the protection of cattle against the disease. The immunity conferred by it only lasts a few days, but it is very useful in cutting short a rapidly spreading outbreak in a village or herd of cattle.

CHAPTER VI.

FOOT-AND-MOUTH DISEASE.

NAMES.—Epizootic aphtha, Aphthous fever. Hind.—*Munhkhur ; Munh ki bimari ; Munh-pau-ki bimari ; Khurpaka ; Khuria ; Rora ; Khora.*

Foot-and-mouth disease is a highly infectious disease characterised by eruptions in the mouth and on the feet, and often on the udder in milch cattle. It affects cattle, including buffaloes, as well as sheep, goats and pigs ; human beings are rarely attacked. Outbreaks of the disease among cattle are very common throughout India, even more so than cattle plague ; it shows a much greater tendency to spread than this disease, and the germ of the disease, which is also an ultra-visible virus, is more resistant, and more frequently spread by indirect means—by persons, fodder, litter, and other articles that have been in contact with the sick animals and also, it seems, through the air.

Whereas in Europe, and particularly in England, great expenditure is entailed in controlling foot-and-mouth disease, in India it is regarded as not worthy of such close attention ; its relatively lower significance is attributable to two reasons mainly :—(i) there prevail in India contagious diseases which cause much greater mortality, notably cattle plague and hæmorrhagic septicæmia, and which therefore demand first attention ; and, (ii) the mortality from the disease among Indian cattle is very low, and would scarcely warrant the application of widespread measures of control, such as would be very difficult to apply, in any case, in Indian conditions.

It is difficult to state what is the death rate from this disease in India. In Europe, it is estimated to be somewhat below five per cent. when the figures are taken of outbreaks for several years. We know that European cattle in India show the disease much more severely when attacked than do the indigenous cattle. However, the disease varies considerably in severity in different outbreaks, and the cattle of some districts, especially of the hills, appear to be more susceptible than those of others. Young calves sometimes succumb to the disease in an acute form ; again, old animals seem to be more susceptible than strong young adult animals.

The losses caused by the disease are not, however, to be measured by the mortality. While the animals are affected they suffer from much loss of condition, mainly from inability to consume their usual food, from diminution or cessation of the milk yield in the case of milch cattle, or from inability to work through lameness in the case of working cattle.

When the available food supply is coarse and scanty, a large number of deaths may thus occur in affected herds, especially among the weaker animals, not so much through the direct effects of the disease, as from the inability of the animals to consume enough food for their sustenance.

The period of incubation in the disease is from 24 hours to seven days. We now know that animals are most likely to spread the disease to healthy cattle in its very earliest stages—during the febrile stage, before the appearance of the characteristic mouth and foot blisters. The clear lymph found inside the blisters (or " vesicles " as they are called) is infective in very minute amounts, and may contaminate clothing, hands, grass, and other things, so that the disease is carried over very long distances. The flesh of diseased animals may retain the infection for some days.

It has been observed that a herd may be affected with foot-and-mouth disease as soon as a month after recovery from a previous attack. The immunity set up after recovery would therefore appear to be a very short-lived one,—contrasting strikingly with the solid immunity after recovery from cattle plague. Recent knowledge has shown, however, that this short immunity is attributable to the existence of more than one strain or breed of the germ, one of which does not bring about an immunity against the other.

SYMPTOMS. There is always at the commencement of the disease some fever, sometimes with dullness, shivering, and loss of appetite; these preliminary symptoms, however, are often very slight, and frequently escape notice. Attention is first drawn usually to the existence of the disease by lameness or soreness of the mouth affecting one or more animals, which quickly spreads to other animals in the vicinity. As a rule, the disease affects both the feet and the mouth, but, not uncommonly, one notices animals in outbreaks, or the whole of the animals affected in an outbreak, suffering from mouth troubles only, and these outbreaks are often of the milder type. The lameness may be first seen by the affected animal shaking one or more limbs, followed by stiffness and restlessness in movements. The mouth affection is first noticed by a peculiar smacking of the lips and then dribbling of saliva from the mouth. The earliest changes in the mouth take the form of small reddened patches, each from the size of a pin's head to that of a four-anna piece, on the surface and sides of the tongue, and often on the gums, inside the cheeks, and elsewhere on the lining of the mouth. Very soon, the lining over these patches is raised, and there exudes a clear straw-coloured liquid underneath, forming a blister or vesicle. The vesicle increases in size, and by the coalescence of a number of smaller ones, may become very large. The lining membrane covering the vesicle then ruptures, and the contents escape, leaving a raw shallow dark-red

eroded surface or ulcer. Large irregular sores are then seen inside the mouth, and these changes take place so quickly that often on first examining an animal ulcers as well as some of the earlier stages are seen; elsewhere, the lining of the mouth is reddened. When the sores are extensive, the irritation inside the mouth is very severe, and this is shown by the profuse dribbling of saliva, which hangs in a frothy mass from the lips.

When the feet are also affected, one notices at about the same time as changes commence inside the mouth, a good deal of heat and pain above the hoofs and inside the clefts of the hoofs. Vesicles and ulcers then appear here in the same way, and they may be seen to affect particularly the skin at the top of the clefts. In very severe cases, where the disease is complicated through dirt infection, ulceration extends between the horn of the hoofs and the soft tissues underneath, resulting, in the worst cases, in separation of the hoofs. These sores are also very prone to become aggravated and enlarged through the action of fly maggots.

In cows, vesicles and ulcers sometimes appear on the skin of the udder and on the teats. The milk supply is diminished, and milking may become so painful through the presence of the sores that the process cannot be undertaken.

The degree of disturbance will depend on the extent of the sores. When they are slight, they may heal up within a few days; on the other hand, when they are extensive they may take a month or more to disappear. In the meantime, the animal's condition is correspondingly upset, through the irritation caused by them and the inability to consume a sufficient ration of food. Cows in calf sometimes abort.

The symptoms are similar in sheep and goats, but in these animals the feet are mainly affected, and they are often seen to progress on their knees, from the pain of supporting themselves on their feet.

TREATMENT. There is no specific treatment for foot-and-mouth disease, but recovery can be considerably accelerated, and complications avoided, by attention to the following points:—(i) Rest the animals as soon as symptoms are noticed, and keep them at rest until the sores are completely healed. (ii) Keep them on dry, clean, firm ground, or, if indoors, keep the floors scrupulously clean and dry, and allow the animals plenty of fresh air. (iii) Try to give the animals throughout sufficient sustenance, that they can take into their mouths and swallow; such as young green grass or very soft hay, soaked corn, mashes, or, if they are unable to take these foods, gruels, such as thin rice gruel frequently, with a few ounces of treacle added, and some salt, which should, in any case, be freely given. (iv) Clean out the mouths when this is possible, by washing with a weak salt solution, or weak borax solution or alum lotion (12). (v) Clean all dirt away from the feet carefully, and, when it is possible, wash the sores thoroughly with salt and water, or, what

is probably not much better, a weak antiseptic (15), or astringent lotion (19); dry them afterwards, and, if practicable, apply a dry wound dressing (18); it is important to attend to these sores frequently, about twice a day, especially when flies are prevalent, and take great care to exclude maggots; if maggots are very persistent, it is a good plan to smear the wounds with tar after cleaning them. (vi) Call in professional assistance in more severe cases, where the hoofs are underrun and maggots have gained entrance. (vii) When a large number of animals have to be treated, an economical plan is to construct a foot bath, such as can be readily devised by placing a tarpaulin sheet in a hollow in the ground, and placing a temporary fence on either side, and filling the trough to a depth of about six inches with antiseptic solution (15, 19). (For foot baths, a good solution is made up by dissolving in each quart of water one dram of copper sulphate.) Drive the animals slowly through this bath two or three times a day. This treatment is useful in the less severe foot cases, but whenever possible, individual attention should be paid to the feet. Another expeditious procedure is to spray the feet from a hose connected with a tank containing the antiseptic solution.

PREVENTION. To prevent the spread of this disease, the general measures for the control of contagious disease, comprising notably the application of standstill orders to all infected and in-contact animals, need to be most vigorously applied, for foot-and-mouth disease shows the most obstinate tendency to rapid spread of all animal diseases. The most complete segregation of the infected animals, kept strictly within the originally infected area, is necessary to prevent spread to healthy animals, which ought to be kept at a distance of several hundred yards from the zone of infection. As has been said before, infected animals are most dangerous at an early stage and before they show distinct signs of the disease, and so within a herd in which some undoubted cases have appeared the disease has already been taken up by a very considerable proportion of the other animals that seem then to be healthy. It is therefore not sufficient to segregate merely the plainly affected animals. Movements of all animals that may have been in contact with the visibly diseased animals should be brought to an immediate standstill; otherwise, it is likely that if some of the still visibly healthy animals which have been exposed to infection are moved among healthy animals some distance away, the scope of the outbreak will be greatly increased. The standstill orders, or segregation, should apply to animals in the infected zone for a month after the last animal has recovered.

What has been said about taking animals over roads or resting them during travel in places where there may have been animals suffering from the disease should be carefully noted.

When foot-and-mouth disease breaks out in a herd, and, as is very likely to be deemed, it is almost impossible to prevent its spread, it is

often considered expedient and advisable to allow it to spread, by artificial means, quickly, so that the disturbances caused by its introduction are got over within a short time. This is effected by smearing the mouths of all animals in the herd with saliva taken from the mouths of the suffering animals. It is a sound procedure, for the saliva is usually very poor in the germ, and often the germ is absent from the saliva, at the later stages (when, of course, the procedure would be useless); it is therefore better to take the mixed saliva of several animals for the application. The disease thus set up is much milder, as a rule, than the disease contracted naturally (often, as has been said, from an infected animal in a very early stage), and the outbreak by these means is not infrequently effectually prevented from lingering on.

Intensive researches are now being carried out in many countries upon this distressing disease; many notable advances in our knowledge upon it have already been recorded, and it is hoped that before long more effectual means will be available for combating it. An anti-serum is prepared, but it is costly, and not always efficacious, because of the plurality of strains of the causal germ. It has also been reported that the injection of certain antiseptics, such as iodine or formalin, into the veins of infected animals in the febrile, pre-eruptive stage brings about rapid cure, and subsequently the animals are immune to the germ of the local outbreak. This knowledge may become very useful soon in immunising cattle exposed to the risks of infection in such conditions as frequently obtain in India. Stock-owners should consult their local veterinary authorities for assistance in view of the possibility that at some near future date some practicable means of intervention of this kind will have become ready to be placed at their disposal.

Milk from affected cows should be boiled before consumption by human beings.

CHAPTER VII.

TICK FEVER.

NAMES.—Red Water ; Texas Fever ; Tropical Red Water ; Bovine piroplasmosis. Hind.—*Zard bukhar ; Lal pishab* (red urine or red water).

Ticks are very common parasites on the skins of cattle and other animals in India, and they are harmful in two ways :—

(*a*) By extracting sustenance from the animals. The amount of blood sucked by ticks from animals heavily infested with these parasites is very large, and the loss is likely to cause pronounced debility, manifested by anæmia, wasting, loss of energy, particularly noticeable in working animals, and a marked diminution in the milk yield of milch cows ; animals infested heavily from their youth in districts where ticks are abundant remain stunted in their growth.

(*b*) By transmitting disease. In India, the diseases transmitted to cattle are redwater or the common tick-fever, and some other less known and less severe affections ; biliary fever to horses ; a common fever known sometimes as malignant jaundice to dogs ; a very common tick-fever of fowls ; a disease, similar to the cattle redwater, of sheep ; and, probably, some fevers of man.

Tick-fever or redwater of cattle is so common in India that experience now shows it to be almost, but not entirely, ubiquitous. In other words, the great majority of the cattle become infected with the disease. And yet, although the disease is one of the most severe and fatal diseases when it attacks cattle in certain countries (the Texas fever of America, which is the same disease, is regarded there as a particularly virulent infection), in India the mortality rate is so low that it is not regarded as a disease of much consequence. The difference in the effects of the disease in different countries is now easy to explain.

The infection transmitted by the tick is a very minute animal parasite, known as a piroplasm, closely related to the malaria parasite, transmitted in like manner, by the bite of a mosquito to man. In a few days—ten to fourteen—after it has been introduced by the bite of the tick, the piroplasm invades, multiplies actively in, and destroys the blood cells containing the red colouring matter. The colouring matter is then excreted by the kidneys with the urine ; the deep red colour of the urine gives the disease the name redwater ; a portion is also

excreted by the liver, in the form of bile pigment, to set up symptoms of marked jaundice, which is very marked in the parallel diseases that affect horses and dogs.

In adult animals, the disease set up by the infection is very severe, resulting in death as a rule. In younger animals, it is less severe, while in calves it is often so mild that nothing more than a slight fever is produced, which, usually, in natural conditions, passes quite unnoticed. Thereafter, the calves, on attaining adolescence, are immune to attacks of the disease. It is easy to show, however, that these recovered and immune cattle have not got rid of the infection, for if one takes a little blood from them and injects it into an adult beast that has never been infected, severe disease, with an abundance of the parasites in its blood, will be set up in this animal, in 7 to 10 days. The tissues of the recovered animal have therefore developed sufficient immunity to keep down the multiplication of the parasite to the degree of harmlessness for the animal itself, though not sufficient to destroy it altogether. Sometimes, however, the immunity becomes broken down; if the animal becomes affected with certain other severe diseases, cattle plague notably, the restraint upon the parasites is weakened, they flare up in activity, and often cause rapid death of the animal.

In India generally, therefore, cattle become infected, almost with certainty, as young calves, by the bites of ticks, that have taken up the infection from "carriers" in the form of the recovered cattle of the surrounding parts; they recover, again almost with certainty; and, later, grow up to be themselves "carriers" of infection.

When adult animals, such as imported European bulls or cattle from some districts in India where the infection does not occur, are introduced into the infected, or so-called enzootic, districts, they are therefore not unlikely to succumb, sooner or later, to acute disease, in the shape of redwater transmitted to them by the bites of ticks infected from the apparently healthy indigenous cattle, that are actually carriers, of the neighbourhood.

In the serum-simultaneous inoculation against cattle plague, infection is likewise apt to be introduced unwittingly with the virulent blood, or "virus", used in the inoculation.

Symptoms. The symptoms vary greatly, as has been explained, in intensity. In the acute disease the first symptom is a sudden rise in temperature, with marked increase in heart action, and some dullness and constipation. Sometimes, animals may succumb suddenly at this stage, without showing the characteristic symptoms of the later stage. Usually, however, acute cases last four or five days, and pronounced redwater is observed: the urine assumes the colour of blood or deep red ink; the animal becomes intensely anæmic, as shown by the whiteness of its eye membranes; and it then wastes rapidly in condition and

becomes exhausted, and dies. Many cases—and they are the kind chiefly seen in India—last much longer, a fortnight or more, and in such cases the period of convalescence is a long and anxious one. In these, the symptoms of the acute disease are not so marked, but the affected animal shows later distinct signs of jaundice, as shown by the yellow colour of the eye membranes; wasting is progressive and very pronounced; the animal becomes weak, dull, loses appetite, and has dropsical swellings under the chest and belly; constipation is followed by diarrhœa; and finally, the animal dies, or else passes into convalescence. A certain diagnosis is made by microscopic examination of the blood for the parasites (which may, however, sometimes be rare in the blood itself at certain stages of the illness). There is some evidence to show that "carrier" animals in India not infrequently suffer from chronic ill-health manifested chiefly by symptoms of progressive anæmia and debility; at any rate, administration of the specific remedy (*trypanblau*) in such cases is reported to be followed very often by rapid improvement (STIRLING).

Post-mortem APPEARANCES. In acute cases, paleness of the tissues generally; dropsical exudates under the skin, and into the belly and chest cavities, and sometimes in a very marked degree into the space around the heart; very marked enlargement of the spleen (two or three times its normal size, but usually not nearly so large as in anthrax); also, some increase in size of the lymphatic glands, which on section are found to be watery. In less acute cases, spleen enlargement may not be noticeable, but the carcase shows very distinct signs of anæmia and jaundice, and congestion of the intestines is often seen; the liver and kidneys are sometimes much enlarged, soft, and yellowish.

TREATMENT. Much advance has been made in recent years, in the treatment of this class of disease, caused by the very minute animal parasites, by the discovery of certain aniline dyes and other chemicals which have a specific action upon them. A certain aniline dye known as *trypanblau* has a remarkable action in this disease if it is given at an early stage. The local veterinary authorities should therefore be consulted at once for treatment as soon as the disease is detected. The dye is dissolved in water (one per cent.), and injected under the skin (50 to 100 c.c.), or into the veins if the symptoms are alarming. The treatment is repeated in six to twenty-four hours if there is no distinct improvement. In places where cases of the disease are likely to make their appearance from time to time, stocks of this drug should always be kept in reserve. Apart from specific treatment, much assistance can be given to the suffering animal by good nursing: appetising, soft food; some laxative medicine, such as common salt (about half a pound), treacle a pound or more), or Epsom salts (about four ounces) daily, while there is

a tendency to constipation; some tonic medicine (5), during the later stages, and especially during convalescence.

PREVENTION. Although in some countries, notably in the United States of America, costly measures have been adopted for eradicating the disease by extermination of cattle ticks, such measures would hardly ever be practicable, and, indeed, it would not be wise to attempt them in India. The reason for making this statement is that the measures, to be successful, would have to be thorough within almost indefinite territorial limits, for if they fell short of this, there would be created zones of clean cattle which on reaching adult life might become contaminated from the existence of "carriers" that had escaped the thorough treatment for tick eradication, and these contaminated animals would then succumb to virulent disease. In the face of the impracticability of effective tick eradication, it is therefore best to allow the existing conditions to continue wherein cattle become almost inevitably infected as calves and are subsequently immune.

Valuable pedigree cattle, imported for breeding purposes, represent an extremely small, but very important, exceptional state of affairs. The risks incurred by such cattle after importation into India are very great, and, indeed, their so-called acclimatisation is largely a matter of passing through the risks of tick-fever. Briefly, what need be stated is that such cattle should be purchased young, not more than eighteen months of age, and application made to the veterinary authorities of the country of origin for inoculation prior to export against redwater. The inoculation consists in injecting the animals with some redwater blood from a carrier: the resulting fever is usually relatively mild, and can be readily controlled by *trypanblau*; the animal is thereafter immune. The inoculation is not altogether safe, but it is considered more economical to face the risk of mortality before the animals have incurred further expenditure in transport. If this procedure cannot be adopted in the country of export, it may be considered prudent to inoculate the animal with the same intent on arrival in India, as is done often inadvertently when it is injected with "virus" in the serum-simultaneous inoculation against cattle plague.

OTHER FORMS OF TICK-FEVER IN CATTLE.

The above, common form of tick-fever in cattle is caused by a piroplasm known as *Piroplasma bigeminum* transmitted, it is believed, by the bites of a tick—*Boophilus* (*Margaropus*) *annulatus australis*—which is a very common cattle tick in India; this tick spends the whole of its existence, (from larval or seed tick stage, nymphal, to the adult stage) on one beast, and then the adult female drops on the ground and lays large numbers of eggs; the redwater piroplasm passes through the egg, to the next generation, which feeds upon another beast.

There is also another, still more minute, piroplasm found in the blood of nearly all Indian cattle (including buffaloes) and called *Theileria mutans*. It is probably transmitted usually by another, extremely common tick *Hyalomma ægyptium*, which drops off its hosts at the successive stages of its existence, and may feed in the younger stages upon other animals than cattle.

The infection is carried from one stage to the following one. The reason why special mention is made of this form of infection is that the parasites may be confused by the unskilled observer with those of red-water: they cause, however, seldom any disturbance in infected cattle and no red-water. On very rare occasions, sporadic cases of extremely severe affection are seen, on the other hand, to be caused by this parasite, and the changes deserved *post-mortem* are indistinguishable from those of the formidable disease known as East Coast fever in Africa; in such cases the parasite appears in exactly the same form as in that disease. (This parasite also almost inevitably contaminates the virulent blood used in the serum-simultaneous inoculations against cattle plague, but it is of no account so far as our experience goes in this condition when the blood is used for the inoculation of cattle born in India; we have observed, however, a fulminating type of disease, set up by it, after an incubation period of about three weeks, in recently imported cattle.)

Some other infections, comprising a common, harmless infection in which a spirochæte is transmitted, and probably another in which the parasite is a very minute piroplasm-like body called an anaplasm, are set up in cattle by ticks in India.

Tick control.

Ticks thrive on cattle kept on uncultivated land covered with rough grass or herbage, in which the youngest forms can hatch out, or, with some ticks, the succeeding forms can moult and prepare for the next stages, find natural protection, and lie in wait for passing beasts. The degree of tick infestation can therefore be kept down by avoiding such areas, but as this may often be quite impracticable, some form of treatment to keep them down in numbers must be recommended to the stock-owner. Ticks are very susceptible to the action of arsenic, in the form of solutions of sodium arsenite (which is poisonous to human beings); some proprietary preparations, notably Cooper's dip, contain this chemical. It can also be made up conveniently, when large quantities are required, by boiling together white arsenic and caustic soda, and diluting the strong solution down further with water until the arsenic content reaches a certain limit; paraffin and soft soap are added, to keep the fluid from decomposition and to assist in penetration of the hair.

The solution, or dip, as it is called, can be applied by spraying, or by causing the cattle to swim (about 30 feet) through a narrow tank of a certain length containing it; the latter procedure is much more effective, and is recommended especially when large numbers of cattle have to be treated. The treatment should be repeated once every fortnight during the season of greatest prevalence of ticks. Further particulars concerning the formula for a dip, and the construction of dipping tanks can be seen in a short article on this subject published in the *Agricultural Journal of India* in March, 1926 (pp. 95—100), or by application through the local veterinary authorities.

CHAPTER VIII.

COW-POX.

NAMES.—Vaccinia. Hind.—*Mata ; Cheeckak.*

Pox or variola is a name given to a class of very contagious disease affecting animals, including man, characterised by peculiar skin eruptions or pocks. Human beings are susceptible to the widespread and well-known small-pox (variola humana). Among the domestic animals sheep are most severely affected when they are attacked, and sheep-pox is one of the most serious contagious diseases of this species in India. Goats become attacked also and the affection from which they suffer varies very much in intensity. One of the most serious contagious diseases of poultry in India is fowl-pox, a disease which differs somewhat in its appearances from the other poxes (the so-called roup is now known to be another form of the same disease). It has been recorded that in the Punjab camel pox is so common that most camels become affected with it between one and two years of age ; hence, older camels are seldom seen affected, but when they are affected they suffer from an acute, generalised form of the disease. Cattle, including buffaloes, suffer, fortunately, from a relatively mild, localised form of pox, and it is fortunate also for the human race that cattle are susceptible to this malady. Horses are also, it seems, susceptible to a mild form of true pox, affecting chiefly the heels, but it is not quite clear yet whether the so-called contagious pustular stomatitis of the horse is a true pox. Pigs in some countries have been said to suffer from pox, affecting rather severely younger pigs.

The poxes as they affect the different species seem to be closely related, but the pox affecting one species is generally peculiar to that species ; that is, it cannot infect another species. A notable exception is cow-pox (variola vaccina), which can affect human beings with a relatively mild localised disease, similar to the cattle disease, and after recovery the human subjects are immune for a very long time against small-pox. This is the basis of the well-known, and now universally practised, Jennerian vaccination against small-pox. The infection of cow-pox would therefore seem to be the same as that of small-pox, very much attenuated by prolonged residence in the tissues of cattle. This view receives support from what is known to take place when the small-pox infection is caused artificially to infect cattle.

The infection itself is a living germ, of the ultra-visible class, very resistant to the effects of disinfectants and desiccation.

Cow-pox is a disease which occurs sporadically or in very limited small outbreaks, and naturally affects only the skin of the udder and teats; rarely, the skin of the scrotum of males; very exceptionally, it spreads to the thighs and other parts of the body. Sucking calves may show the disease on the lips and muzzle.

When it appears on an establishment it is spread usually by the hands of milkers, and sometimes by contaminated litter and floors. It is reported to be introduced very often by persons who are reacting to the vaccination against small-pox. (In India, it is not improbable that the disease often arises as cow-pox from prevailing outbreaks of human small-pox.)

The period of incubation is from four to seven days.

SYMPTOMS. In cattle, the first symptoms are those of a mild fever, with a diminution in the milk yield; these symptoms are often so slight that they pass unnoticed. Then follow in two or three days, an appreciable reddening and swelling of the teats and surrounding parts; in two or three days, small firm nodules, from the size of a lentil to a pea, appear, which increase somewhat in size, and in a day or two become converted into blisters, or vesicles, each filled with a clear transparent lymph. The vesicles are of a reddish, bluish, yellowish or shiny white colour, depending upon the thickness of the skin; on the body of the udder they are regularly round, while on the teats they are oval, and they are each surrounded with a narrow reddened zone. The vesicles take from 8 to 11 days to ripen, and towards the end of this period each has a dimpled or umbilicated surface, and the contents have become turbid or cloudy; they have now reached the pustular stage. The pustules then dry up, and the covering skin and matter become detached in the form of brown scales or scabs, leaving red, swollen patches, which heal up to form smooth, white, depressed scars.

The number of vesicles that appears varies considerably: sometimes only one or two, sometimes more, and exceptionally nearly twenty. They do not all appear at the same time, and an interval of 4 to 14 days separates the appearance of the first and last vesicles.

TREATMENT. In the early stages, when the teats and udder are congested, it is well to administer a laxative or purge (1), and to keep the animal on a soft, low diet. Particular attention must be paid, however, to the teat and udder, and the milk removed with as little disturbance to the sores as possible. This disturbance is minimised by using a metal tube (a teat syphon), that has been carefully sterilised by boiling beforehand, for withdrawing the milk. It is preferable to withdraw the milk artificially than to allow the calves to suck. Ruptured vesicles should then be washed with clean water or a mild antiseptic solution, such as boric lotion (12), dried thoroughly, and smeared with zinc or boric ointment, or dusted with a little boric powder. The milk

should not be used for human consumption unless it has been thoroughly boiled.

PREVENTION. Affected cows should be isolated, and attended to and milked by separate milkers, who should disinfect their hands carefully after milking or treating the udder. It must be remembered that the disease can be communicated in this way to the hands and arms of human beings, who have not been vaccinated against small-pox or previously infected.

It is possible to vaccinate cattle against this disease quite readily by applying cow-pox lymph, such as is used in small-pox vaccination to a scarified area of skin anywhere on the body. The procedure will hardly need application except when cow-pox of an unusual degree of severity is spreading in the vicinity.

CHAPTER IX.

TUBERCULOSIS.

NAMES.—Consumption; Phthisis. Hind.—*Sukha*; *Khanazir*; *Kshaya*.

Tuberculosis is the most perplexing disease of cattle in Western countries, affecting, it is estimated, about 30 per cent. of the cattle population, and not long ago it was authoritatively stated that there were probably not ten large herds in England, not affected with the disease. Even in the West, it is not, however, the disease that causes most actual loss to the stock-owner himself—for, economically, it is perhaps exceeded in gravity by contagious abortion. Its importance is accentuated by the knowledge that its persistence among the cattle constitutes a source of grave danger to the human population, for the disease is communicable to man through the milk of infected cows, and we have abundant proofs that a considerable proportion of cases of human tuberculosis—notably, the great majority of cases of abdominal tuberculosis in children, a large percentage of bone and joint tuberculosis in adults, and a very considerable portion of cases of cervical gland tuberculosis—are caused by infection of bovine origin.

Happily, in India bovine tuberculosis is a relatively rare disease. In the examination of carcases made at certain slaughter houses, it was found that somewhat under 3 per cent. were affected with visible signs of the disease, and even in the affected carcases the disease changes were relatively much restricted in distribution and mild.* It is only in extremely rare instances that we have obtained information pointing to its spread upon establishments in India in a manner analogous to that commonly observed in Western herds (namely, once in a certain herd of conservancy bullocks and once in a Military Dairy, to the author's

* Recent knowledge that has come to the author's notice since the text of this book was revised seems to indicate that these statements need modification. SOPARKAR (1927) has found on careful search for tuberculous changes in cattle at the Lahore and Ferozepore slaughter-houses an incidence of about 15 per cent.; the changes were all minute. Again, the proportion of cattle that reacts in herds to the tuberculin test is sometimes relatively high, and it has been discovered that from some reacting animals the germs of the disease can be isolated in the laboratory, although no tuberculous changes can be observed with the naked eye in the bodies of the animals. Further, it has been stated (HUTCHINSON) that the cases of human tuberculosis of which a very noteworthy proportion is caused by the cattle germs (notably, cases of so-called surgical tuberculosis) bear in India approximately the same numerical relationship to the other cases (which are known to be caused entirely, or nearly entirely, by germs of purely human origin—principally, the pulmonary forms of tuberculosis) as they are known to bear in Europe, where infection of human beings commonly with cattle germs has long been established. It would therefore be premature to conclude, in the present state of our knowledge, that cattle tuberculosis is of negligible importance in India.

knowledge). These exceptions are, nevertheless, of the utmost potential significance to the prospective owner or breeder of stock, in conditions simulating those of the intensive domestication of Western Europe. We have now definite knowledge that the infective germs in natural cattle tuberculosis in India are no less virulent than those of Europe. The susceptibility of cattle in India has been tested, and although it may be construed that they actually present some difference in this respect from those of Europe, the important factor regulating the low incidence of the disease hitherto seems, with little or no doubt, to be the common natural mode of life of Indian cattle—in the open or unhoused —a factor which accounts likewise for the very low incidence in the West of the disease among sheep and goats, animals which, in reality, are otherwise highly susceptible to the disease.

Tuberculosis is a specific infectious disease caused by a certain *germ, which can live only in the bodies of animals or man.*

The germ does not propagate in the outside world. It soon perishes under the action of sunlight. It is usually transmitted from beast to beast by the inhalation of the fine spray coughed up from the lungs of the diseased animal and sometimes of dust particles containing the settled germs discharged from the diseased animal. Not infrequently, it is contracted by feeding on infected food, and this is particularly evident in the case of calves fed on infected milk. It is extremely seldom hereditarily transmitted : in fact, in badly infected centres in Europe, where over 30 per cent. of the cattle are infected, it has been computed that only one in 500 calves shows signs of tuberculosis at birth.

Tuberculosis can never arise therefore except from a pre-existing case of infection. It is facilitated in its spread and intensified in severity by continued close contact of diseased and healthy animals, and hence in the open air the chances of propagation are minimal, whereas inside close habitations they are at their highest. Housing within commodious, well-ventilated buildings tends to diminish or retard the spread ; it does not get rid of the disease, for this can be achieved only by getting rid of all infected animals.

The germ which causes phthisis or lung tuberculosis in man differs a little from the bovine germ ; notably, the so-called human type does not naturally affect cattle. The bovine type does, however, as has been stated, often affects human beings. There is another "type" of the germ, namely the one which very commonly causes tuberculosis in fowls everywhere, including India, the "avian type" ; this type very seldom affects cattle, and when it does, it is with a very mild disease, and it does not affect man naturally, although on very rare occasions man has become accidently infected, with a relatively mild disease. The disease has been discovered in India also in horses and mules, elephants and swine. Buffaloes seem to be about as susceptible as other cattle.

SYMPTOMS. Most commonly, the disease affects the chest contents —the lungs, bronchi, and bronchial glands, and so the symptoms usually are those of respiratory derangement, cough and chronic wasting. In advanced, so-called generalised cases, these symptoms are very pronounced, and the animal wastes away rapidly. As a rule, however, the disease is very slowly progressive, and during its lifetime the animal may suffer from several attacks of pneumonia from which it temporarily recovers, or from abdominal derangements, such as recurrent tympanites, due to pressure of the chest glands on the gullet, intermittent diarrhœa, and other confusing and often not very distinct symptoms. In fact, it is not exceptional to find that the lifetime of the animal is not appreciably shortened when it is affected, with mild tuberculosis, but in a herd, and especially in a housed herd, such slightly affected animals must be regarded as dangerous carriers of infection. In infected milch cattle, the udder not infrequently becomes affected, and the changes in it are a very slowly progressive hardening and enlargement, without pain, of one or more quarters, with, at first, slight diminution and thinning of the milk, and finally the conversion of the secretion into a yellowish fluid with a ropy deposit and greatly diminished in amount. In calves, fed on infected milk, the predominant symptoms are abdominal.

Post-mortem APPEARANCES. The disease usually is easily diagnosed on examination of the carcase, by the presence of the so-called tubercles, or tuberculous changes, in certain tissues, notably the lungs, bronchial and mediastinal glands, pharyngeal glands, liver and hepatic glands, and more rarely and less distinctly in the spleen and kidneys ; in advanced cases, the so-called " grapes " are visible on the pleura and peritoneum. In India, minute tubercles may be found fairly commonly on careful search of the mesenteric glands, that is, the glands lying adjacent to the intestines. The tubercles commence as consolidated masses of tissue, which later degenerate into a cheesy and gritty material. The udder tissue, when affected, becomes diffusely consolidated and then degenerates. In advanced, generalised tuberculosis, the tubercles seen may each not exceed millet seed in size and are extremely numerous in the lung tissue.

TREATMENT. No certainly efficacious treatment is known, though it is well-known that patients may take, often quite unexpectedly, a turn for the better when left quite alone, and the best treatment is to rest the patient and keep him in such condition of comfort as will tend to strengthen his natural resistance. Treatment of cattle in India is, however, not recommended.

PREVENTION. The problem in India is at present a very simple, straightforward one. In Europe, on the other hand, it is most baffling, and almost insoluble, unless some effective means of prevention, other than those hitherto attempted, are found and proved to be readily prac-

ticable. The reason for the difficulty in Europe is the high incidence of infection, which renders the compulsory drastic eradication of infected animals a task beyond the financial capacity of any State ; it has been said authoritatively that such a measure could not be contemplated unless, or until, the natural incidence fell somewhere below 10 per cent. In India, we are now well below this threshold of effective action, and, with the predicament of Europe in mind, the only wise course to adopt in any herd in which the disease is diagnosed is to eradicate infection drastically and immediately ; this refers with especial force to herds of cattle which are housed during a part of their maintenance. It is essential to eradicate not only the visibly affected animals, but also all those animals that are infected but not showing visible signs of infection, and are " carriers " of infection in the herd. These carriers can be detected by means of the " tuberculin test," a test which must be applied by an expert veterinarian, and consists in injecting the animals to be tested with a liquid containing in solution some of the extracted, chemical constituents of the tubercle germs : infected animals react by a rise in body temperature, or a local reaction visible when the material is injected into certain parts of the skin ; no change is seen in healthy animals. A pamphlet is issued from the Muktesar Institute on the mode of testing. After the first test, further tests should be undertaken at intervals of six months until no more reactors are detected, and subsequently at more prolonged intervals.

This disease has been described at what may appear to be undue length having regard to its present importance in India, in view of the opportunities that are now afforded to us for taking timely and effective measures to prevent its becoming a menace to livestock improvement.

CHAPTER X.

JOHNE'S DISEASE.

NAMES.—Enteritis paratuberculosa bovis (specifica); Chronic bacterial enteritis of cattle. Hind.—*Vah ; Dast.*

Johne's disease is an infectious disease of cattle manifested by symptoms of chronic diarrhœa and wasting, caused by the invasion of certain parts of the intestine with a specific germ. This germ shows considerable resemblance to that of tuberculosis when examined in the laboratory; hence, the name paratuberculous enteritis, sometimes given to the disease. The disease is, however, not tuberculosis: "tubercles" are never seen in it; the causal germ cannot set up tuberculosis; and, the disease changes are not likely to be seen in many parts of the body, as in tuberculosis, but only in the mucous membrane of certain parts of the bowel and the adjacent lymphatic glands. In its general attributes, the germ shows greater kinship with that of human leprosy (another member of the so-called acid-fast group of bacteria). Cattle, including buffaloes, are chiefly affected with the disease. It is one of the worst scourges of cattle in Western countries, and our present information goes to show that it is a very serious affection in some important herds in India, of much more actual moment than tuberculosis. Sheep, goats and wild deer are also known to become infected. So far as we know, other animals, including man, are not naturally infected. The disease is spread by grazing on land contaminated with the dung of diseased cattle, which, in the stage of diarrhœa, void large numbers of the specific germ on the ground. The intensity of spread will therefore depend largely upon the degree of stocking of the pasture and the numbers of infected animals among those kept upon it. The period of incubation is an exceptionally long one—estimated at from 6 to 18 months, but it is likely that numbers of animals carry infection for an indefinitely longer time without presenting visible symptoms, and thus constitute reservoirs of infection. The disease is therefore a disease of adult animals, usually over two years old, and the majority of cases are seen in much older animals.

SYMPTOMS. The commencing symptoms are often rather vague; the animal appears to be affected with recurrent very mild attacks of "indigestion"; it commences to lose condition in spite of a good appetite, and the dung shows a tendency to looseness from time to time. Next, wasting in condition and looseness of the bowels become more striking—symptoms which may be very apparent for several days, alternated with periods when the animal seems quite normal. This

state may continue for several weeks, progressing gradually in intensity, until eventually the diarrhœa becomes most pronounced and the condition of the animal emaciated; the dung runs away almost like water and contains very little solid matter in suspension. The appetite is, however, well maintained. Finally, the animal becomes too weak to stand, lies down prostrate and succumbs.

Post-mortem Appearances. Often these are very characteristic and they are always of the same kind. The disease affects the mucous membrane of a certain portion of the intestines, namely the terminal portion, hardly ever extending beyond the posterior third, of the small intestine, and the commencement, notably, of the large intestine. The mucous membrane becomes thickened and firmer; and, particularly in the affected small intestine, it becomes thrown into thick corrugations or folds that cannot be stretched out smooth as they can in the normal intestine. The adjacent mesenteric glands are enlarged somewhat, but there is often no very distinct change in their texture. The germs of the disease are frequently found in enormous numbers in the affected membrane, but they often become greatly diminished in numbers just before death. Four stages may therefore be recognised:—(i) a very prolonged prodromal stage, in which the germs can hardly ever be found on examination; (ii) an early clinical stage, in which the germs are found in large numbers, but there are no visible changes in the gut; (iii) the typical, clinical stage, in which the germs are numerous, and the gut changes conspicuous; (iv) the advanced stage, in which the gut changes are marked and the germs have largely disappeared. Recognition of these arbitrarily divided stages is important in view of what has to be said later regarding prevention.

Treatment. Certain medicines can produce a temporary amelioration in the symptoms; for example, certain astringents, such as the sulphates of iron and copper can produce this effect, especially when combined with dry feeding of the animal. A relapse of symptoms inevitably occurs, however, when the treatment is stopped or the animal is put on to soft or green food. Treatment, in the present state of knowledge, is therefore not advised, except in very special circumstances, as when it is desired to tide over until calving time the disease in a pregnant cow the offspring of which is much desired.

Prevention. Most difficult, when once the disease has appeared in the herd. The factors that make for rapid or slow spread of the disease have been touched upon at the commencement of this chapter, and the policy to be adopted will depend upon (i) the value and utility of the herd and (ii) the incidence of infection. When once the disease is suspected, the expert veterinarian should be called in to make a definite diagnosis, which can be established by *post-mortem* examination of one or more animals showing distinct symptoms. The next step that should

be taken is to test all the animals with a special form of tuberculin for the diagnosis of carriers.

This is done by the use of avian tuberculin, for ordinary bovine or human tuberculin does not give a reaction with Johne's disease; "Johnin", the tuberculin made from the Johne germs themselves, does not appear to be better than avian tuberculin; this phenomenon indicates an affinity between the Johne germs and those of fowl tuberculosis; both these latter products give also a reaction with bovine tuberculosis, and so the existence of this disease must be excluded by a preliminary or simultaneous test. A pamphlet describing the test is issued from the Muktesar Institute.

A curious circumstance about the test is that it seems to indicate very well the animals falling into categories (i) and (ii) enumerated in the paragraph above describing "*post-mortem* appearances"; it is not so demonstrative with (iii), and it often fails completely with (iv). This failure to evoke a reaction in the later stages is well-known with the ordinary tuberculin test for the detection of tuberculosis, but it is much more marked with Johne's disease than with tuberculosis. The later stages, however, are readily diagnosable by direct means.

When the animals diagnosed as infected are not of exceptional value, such as are, for example, valuable pedigree animals, the best plan is to eradicate them completely from the herd. It would, of course, be criminal morally to disperse them among other establishments. When the incidence is very high, however, experience has shown that the total obliteration of the herd may be necessary to eradicate the infection, for the degree of environmental contamination is then likely to be so great that the numbers found newly infected at repeated subsequent tests would discourage hope that the disease could be eradicated by this tedious system. If this state of affairs were discovered to exist in a valuable foundation herd, an efficacious system of vaccination, if available, would be of the greatest value in conserving its existence.

CHAPTER XI.

ABORTION.

NAMES.—Premature Calving. Hind.—*Isquat-e-hamal* (Urdu).

Abortion, or expulsion of the young from the womb before the termination of the normal period of gestation, is one of the most distressing complaints of cows ; in the West it is perhaps the most exasperating affliction from the stock-owner's point of view, for in a dairy herd it means that the affected cows have to remain often a source of dead loss until a subsequent normal gestation is accomplished, and in a purely breeding herd it means that valuable progeny is lost. The abortion may be sporadic—that is, single cases only may occur from time to time ; on the other hand, the abortion very frequently occurs in the form of veritable outbreaks, affecting a large proportion of the cows in a herd during a breeding season, and it is this so-called epizootic abortion that becomes a source of grave distress to the owner. The affection does not attract the same attention in India at present, for epizootic abortion rarely becomes a very noticeable complaint in indigenous herds ; nevertheless, it has been ascertained that in some important dairy herds over 20 per cent. of the cows may abort in the course of the year and that this experience may be repeated to a large extent for a number of years.

When single cases occur in a herd they are often put down to accident. It is now known that accidents, such as rough handling, seldom cause abortion in cows, although in other species, such as sheep, accidental abortion is quite common. Again, bad or deficient food and polluted water have often been suspected, but, in fact, these must be very rare causes ; perhaps, they are not uncommon causes of sterility. It can be safely stated that well over 90 per cent. of cases in cows are due to infection, and the infection again is that of a specific germ, the bovine contagious abortion organism (*Bacillus abortus*, Bang). In some mild outbreaks, another type of germ (*Vibrio fetus*) is responsible, and indeed, abortion may be caused occasionally by several different kinds of germs – such as the tuberculosis germ, the surra parasite, or the cattle-plague germ. It is known that in severe and mild outbreaks of disease one of the most noticeable symptoms is abortion among the cows, and so it may happen that in outbreaks of cattle plague or in the occasional outbreaks that occur in cattle of surra, the number of aborting cows is high. The reason why abortion is frequent in infectious disease is that the infection finds its way into the attachment between the lining of the womb and the membranes (the chorion) covering the young, with the result that the latter are loosened, and are then forcibly expelled.

The common infective germ of cattle abortion possesses this quality of being able to multiply in the attachments between the womb and the chorion or afterbirth to an extraordinary and specific degree; it causes no disease elsewhere in the body than in the pregnant womb, though it can survive, without causing apparent disease, for many years in the tissues of the udder, and it is restricted to this shelter, it seems, between the successive periods of pregnancy. A cow may therefore abort or give birth to dead calves, two or three times; in India, cows have been noted to abort as many as four times in succession; the infection each time is derived from the existing, dormant infection, in the body (or the udder, more precisely). Subsequently, it is likely that the cow will give birth to a full-time calf, or one that is slightly premature, but yet alive; however, the afterbirth on these occasions will still be found on examination to contain some infection, but not sufficient in extent to cause early abortion as in the previous pregnancies. Later, the cow will most probably give birth to a succession of quite normal calves; yet the afterbirth even in these calvings may be found to contain slight infection. Such a history would represent that of a severely affected cow, such as one finds sometimes in a badly infected herd. It is possible now by means of a laboratory test (the agglutination test) on a small sample of blood from cows to tell accurately whether they are infected with the specific germ or not, and it is also possible by certain methods to grow the germ outside the body from the infected animals. It has been proved in this way that many cattle in a herd can carry the germ, but not abort at all: the changes caused by it in the afterbirth are so slight that the calf does not come away before the normal date of birth. A state that represents more severe infection, is when the calf comes away prematurely, but alive. And again, a still more advanced state is when the infection is so severe that the afterbirth is detached, and the foetus comes away dead, from the third to the seventh month of pregnancy.

In India, it has been found in some localities, where the cattle are maintained on large stretches of land, in the open, and never housed, that they may be infected to the extent of about 10 per cent. and never abort—at least not from this common, specific infection. In some large dairy herds, consisting of high-yielding cows, kept on restricted areas and largely housed, the percentage of infection has been known to rise to fifty, and of actual abortion to twenty or more, and in such herds cows often abort two or three times in succession.

Infection is transmitted by feeding upon material contaminated with the diseased afterbirths, or with discharges soon after the act of abortion, of affected cows. The bull may become infected, but has never been proved actually to transmit the disease. The milk of infected cows contains the germ.

Calves show a high degree of resistence to infection. Heifers at the time of first calving are quite susceptible.

The symptoms of common abortion need not be described. The afterbirth often presents peculiar alterations. Some or many of the little masses of tissue (cotyledons) on the surface show a blanched appearance, and there is a sticky, yellowish to chocolate coloured, soft exudate on some of them. This material contains the germs in great abundance. After abortion, the cow may discharge a secretion from her genital tract for some time, and often the tract becomes infected secondarily with other germs, which may cause a distinct inflammation of the womb, or a very slight one, which is often the cause of sterility. Aborting cows frequently suffer also from retained afterbirth.

Treatment. There is no medicinal treatment of any value. In cases of retained afterbirth, it is often necessary to call in professional aid to take it away carefully by hand and irrigate the womb copiously with a suitable mild antiseptic (such as one dram of permanganate of potash dissolved in four seers of water). In cases of persistent heavy discharge from the vagina following upon abortion it is also a wise plan to resort to repeated copious irrigation, with the object of removing all diseased material from the womb.

Prevention. This is the most important aspect of control. Care should be taken not to purchase cows from herds where the disease is known to prevail. The admission of an apparently healthy cow from a diseased establishment is often the precursor of a severe outbreak. When a case of abortion occurs in a herd it should be suspected to be of the contagious kind until it is proved to be otherwise. Hence, professional aid should be called in, and a sample of blood tested at the laboratory. (Full instructions are issued by the Muktesar Institute.) If the case is returned as one of undoubted infection, it should be well isolated, and the other cattle tested to ascertain the extent to which the infection has already spread. If it is then found that the infection has spread to only a small proportion of cattle, these should be rigorously isolated from the other cattle (separate sheds, attendants and pastures) for an indefinitely long time. The clean cattle should then be tested at intervals of every six months to a year, so that any more animals that escaped undetected at earlier tests can be segregated. It is quite possible to control the disease by this method, but except in very rare circumstances, the recommendation of its adoption would be an impracticable counsel of perfection for herds as they are ordinarily maintained in India, or even for the most part in other countries; the method is here described merely to show the difficulty of controlling the disease once it has broken out in a herd.

Vaccination. Not always a very successful procedure, but sometimes better than leaving the herd alone. The only effective form of vaccine

consists of a live culture of the germ and as issued from the Muktesar Institute it is now a harmless one, through long cultivation in the laboratory, grown on solid media and comprising the " types " discovered in India. Instructions for use can be obtained from the Institute. It is never recommended for use in herds in which the disease does not clearly exist. It is best applied to all the breeding cattle that have not aborted at a stage when very few abortions have already occurred. When the disease has become widespread and intense, the immunity set up by it is not sufficient to withstand the virulence of the natural infection. It should be injected into the breeding cattle about two months before the anticipated date of service. The breeding programme need not be held up or delayed for the vaccination. The work should be done by a veterinarian.

Contagious abortion is what is known as a self-limiting disease—that is, in a herd not recruited from time to time with fresh admissions of clean cattle it has a natural tendency to die out. It has been explained at the commencement of the chapter that infected cattle may abort once or more times and then give birth to normal calves, although they still carry infection. This occurs generally throughout a herd in which the disease appears, and so after one or more years the outbreak will stop. Hence, it is bad policy to sell off the aborting cows, and purchase new stock, for the former are likely to calve normally if retained, whereas the latter will probably soon recommence the same history.

CHAPTER XII.

STERILITY.

NAMES.—Hind.—*Banjh ; Sud.*

Sterility, or failure to come in calf after service, is economically often a source of anxiety to the stock-owner. Cases may be sporadic or multiple within a herd ; the number may often be so considerable that the condition assumes the appearance of an outbreak. It generally occurs in cows that have calved once or more times, but outbreaks have also been reported in heifers that have never calved.

Much has been written lately about this disease, but it must be confessed that our knowledge upon it is still very confused. Occasionally, it may be caused by some congenital defect in the genital system. Sometimes, a sort of gonorrhœa (" bull-burnt ", infectious vaginitis) that is transmitted by the bull during service brings about temporary sterility. This condition can be satisfactorily treated by douching the genital passage with a mild antiseptic daily. What has been described as a widespread disease and termed " contagious granular vaginitis " appears to be in reality a normal condition of the vaginal tract of cows, which often shows a granular appearance, especially after slight manipulation.

The great majority of cases are, however, relatively obscure. The most recent evidence seems to show that they are largely due to a very mild inflammation of the lining of the womb (endometritis), with certain infective germs, and that in this state also the ovary does not pass through its normal sequence of changes, and contains retained yellow bodies. The endometritis is frequently, it seems, a sequel to contagious abortion, and sometimes of very mild, or " carrier " cases, of this infection.

The stock-owner is advised to call in expert professional aid when he is confronted with this condition, for no precise rules of treatment can be given here.

Cattle in India nearly always show much less tendency to come early into calf than do European cattle, and the intervals between successive gestations are relatively very long, rendering them uneconomical from the point of view of intensive dairying. This retardation in sexual development, which is rather curious when compared with the relative acceleration in the human subjects, is to some extent dependent upon the food supplies, but to a greater extent it is rendered relatively conspicuous by the selective breeding for early maturity that has taken place in the best European breeds.

CHAPTER XIII.

DISEASES CAUSED BY WORM PARASITES.

NAME.—Helminthiases. Hind.—*Kiron ki bimari.*

The attention given in writings to the diseases of cattle caused by worm parasites in India has been very small, when one considers that there is probably no beast in the country that is not infected with many kinds of worms, and a short experience in the examination of carcases of dead cattle from different parts of the country is sufficient to force conviction that this class of disease is the cause of incalculable loss to the stock-owner. The reason why this kind of disease often escapes serious notice is that outbreaks causing sudden large mortality are not common, except in certain, very wet years, and at certain seasons ; the losses suffered are therefore accepted as almost inevitable, whilst the stock-owner is preoccupied mostly by the more fatal plagues. The losses caused by worm parasites are insidious and, as already said, not often shown by a suddden high death-rate in the herd ; the symptoms are chiefly unthriftiness, wasting and anæmia, affecting seriously the younger animals and often scar ely noticeable in older ones.

In human beings, the great importance of hookworm infection in producing debility in the inhabitants of warm countries is now being realised. In the domestic animals, there are several diseases of the same, or greater, severity, caused by worms, and the reasons why worm diseases assume greater significance in animals are plain even to the casual observer. The parasitic worms have a somewhat complex life-history. Usually, but not always, it is the adult worm that is found in the bodies of animals, and causes damage there ; the damage is often serious in young animals, due to the large numbers of worms that may develop in their bodies, while in older animals it may be small or quite inapparent, due to the restraint exercised by their tissues on the development of the worms ; the older animals maintain the parasites, in relatively small numbers, from one season to another. The adult worm then lays a large number of eggs, usually while it is still in the body of the animal, and the eggs are evacuated with the dung (and to some extent coughed up in lung-worm infection of calves), and find their way on to the ground. In suitable conditions of moisture, shade, and warmth, the eggs hatch out, and the embryos then pass through two or more larval stages on the ground, after which they climb up the blades of grass and become ensheathed with stout capsules, so that in this form they can resist adverse conditions, of heat or cold, sunlight and dryness for a long time—often a whole year or more ; they

may reach this stage sometimes in as short a period as ten days after the egg has been dropped on the ground. With some worms, such as the common liver fluke of cattle and sheep, the life-history is more complicated : the young form requires for its development in the outside world to pass a certain stage or stages in the body of a so-called intermediate host. With the common liver fluke, this intermediate host is a certain species of fresh-water snail (the species seems to vary in different countries), and after a sojourn in the tissues of the snail, the young fluke emerges as a tadpole-like organism, which swims actively until it reaches a blade of grass, on which it becomes encysted, or ensheathed.

The young, encysted forms of the worms are next swallowed by the animals while grazing ; sometimes, they may be swallowed even in the dry food indoors. They develop then inside the body through successive stages, and often after undergoing curiously involved migrations in the tissues, to the sexually mature adult stages. Thus, it is now known that the young liver fluke does not enter the liver directly by passing up the main bile duct, but perforates the intestines, wanders through the belly cavity, and penetrates the liver through its outer surface. It is also now generally believed that the lung worms of calves reach the lung and windpipe chiefly by perforating the gut and wandering through the body till they finally reach the air passages of the lung.

Rarely, the young worms, after undergoing their development on the ground, do not enter the body mainly with the food ; in the case of hookworm disease of man, the ripe larvæ penetrate the skin, usually of the bare feet, and wander through the body until they reach the special part of the gut (the duodenum, or first part of the intestine) where they can develop further and cause their ill-effects. The somewhat similar hookworms of cattle are said to reach the gut in the same way.

With the intestinal tapeworms, the life-history is again complicated. The hydatid cysts found in large numbers in the tissues of cattle and other animals in India are structures containing a certain stage in the development of a common, small intestinal tapeworm of the dog. Inside the covering of the cyst there are numerous heads exactly resembling those of the adult tapeworm. When the animal dies, or is killed, and the liver or other organs containing the cysts are eaten by a dog, each head attaches itself to the gut wall and then its other end grows until a full-sized tapeworm develops, and casts off segments, full of ripe eggs, which are shed on the ground with the fæces of the dog. When a beast now drinks water or eats grass into which the eggs have been dropped a few days previously, there emerge from these eggs in the stomach or intestines small embryos, which penetrate through the gut wall, find their way into the tissues, and each then develops into

a cyst, which may eventually contain several hundred heads of the next generation of tapeworms. In sheep, the cyst may often grow in the brain, and cause the peculiar symptoms known as "gid." In man, also, infected by drinking water containing the eggs, the cysts may likewise cause grave damage when they develop in delicate organs.

It is essential that the stock-owner should realise these few elementary points in the development of the worm parasites, as without this understanding he will be at a loss to devise rational measures to mitigate the damage caused by them in his cattle. The conditions that determine severe worm infection in certain herds and in certain localities, at certain seasons, can now be readily appreciated. With the common worm diseases of cattle, it is the adult animals that harbour infection continuously, by maintaining a few parasites in a subdued state of development in their bodies. A large number of eggs from these animals are voided with the dung upon the pasture, and the number of eggs voided will be increasingly larger according to the degree of overstocking of the pasture. In dry, bright hot sunny, or frosty, weather, on high, dry ground, the eggs stand little chance of hatching out young forms that will develop further; they perish in these conditions. On the other hand, in wet, cloudy weather, on flooded or water-logged land, and particularly if the weather is warm, nearly all the eggs hatch out, and the young forms develop quickly, often in ten days, to the resistant stages, capable of infecting fresh animals, and of remaining infective for a long time (up to a year), even though the outside conditions should turn again unfavourable. A sharp frost, or a prolonged cold winter, in temperate countries helps to kill off more quickly these resistant forms. The farmer welcomes such weather, for he knows that it cleanses the land for his stock by the time the grass grows again the following year.

In India, however, it will now be clear, the conditions in many localities are almost ideal for rapid and intensive propagation of worm parasites. The frequent heavy and varied parasitic infections which are seen in carcases received for examination and which one sees relatively rarely in similar examinations in countries with a different, cooler climate are likewise clearly appreciated.

Again, the relatively greater importance of worm diseases in animals generally comes from the fact that they soil their food naturally with their excrements and then eat it. The excrements contain the infection which later is taken up with the food of other animals. Human beings, who subsist on cooked or specially prepared foods, are seldom exposed to infection in this way.

The worst forms of worm infection of cattle and buffaloes are the following :—

Stomach worms. A number of species of small worms inhabit the fourth, or true digestive, stomach of ruminants. These so-called strongyles

are in their adult stages about the size and shape of pins—very small or medium-sized—and are not easy to see with the unaided eye. They are present in small numbers on the lining of most stomachs, but sometimes the lining is seething with them, and then they cause indigestion, wasting, anæmia, and diarrhœa. Young animals are prone to massive infection of this kind, and succumb often in a short time. Cattle are not so susceptible as sheep and goats to the bad effects of the invasion.

Hookworms. These small hook-shaped worms (sometimes called bunostomes in cattle) attack the lining of the first part of the intestine or duodenum, and cause severe anæmia by sucking blood from the membrane. They are not so important in cattle as are worms of the same class in man and dogs, but in India they often seem to contribute largely to the severity of losses in parasitic outbreaks in cattle and other ruminants.

Nodular worms. These are again small worms, sometimes called œsophagostomes, which attack the small gut, and produce a pimply condition on the surface. The younger stages that invade the intestine burrow into the gut-wall and set up there small nodules ; the adults come back into the lumen of the gut, and are harmless in themselves. Nodular worm disease is often a cause of serious loss in lambs ; it does not seem to affect cattle so severely, but in outbreaks of parasitic disease in India they seem to contribute also largely sometimes to the mortality among younger cattle. The symptoms produced are diarrhœa, wasting, and anæmia.

Lungworms. These are also small worms, or strongyles, that invade the upper air passages—the windpipe and bronchi—and cause in calves and young cattle symptoms of a form of bronchitis commonly known as " husk " or " hoose," from the peculiar sound of the persistent cough emitted by the affected animals. As the disease progresses, the animals show much discharge of frothy material from the mouth and nose, waste rapidly in condition, often show diarrhœa, also marked anæmia, and succumb. Older animals are resistant. Lambs are also commonly affected with similar disease.

Syngamus. A small red worm, similar to that which commonly causes " gapes " in poultry, is frequently seen in the throats of cattle in India, but seldom seems to cause bad effects.

Ascarids. Round worms, much larger than the above and similar to the common round worm of children, found in the small gut of calves sometimes, and cause wasting and diarrhœa.

Tapeworms. Usually of small importance in cattle.

Liver fluke. Important ; affects cattle and buffaloes, almost universally in India, but the affection, often known as liver-rot, is seldom so severe as it frequently is in sheep. The adult flukes are flat leaf-

shaped parasites found in the bile ducts. Their life-history has already been noted. In a few, severe outbreaks, the young forms produce a severe inflammation of the liver when they burrow into its substance to get into the bile ducts. Usually, however, it is the adult flukes that set up disease by causing persistent irritation inside the bile ducts; the surrounding liver tissue becomes replaced with fibrous tissue, and so the functions of the liver are impaired. It has been computed that distinct general symptoms are seen in cattle when the liver contains about 250 flukes; in sheep, when it contains about 50. The symptoms, usually chronic, are wasting, anæmia, dullness and weakness. In sheep, dropsy under the skin of the jaw and elsewhere is a common terminal symptom. Young animals are again much more severely affected than older ones.

Amphistomes. Small rounded or conical worms, like swollen tapioca or sago grains, commonly seen in the first stomachs of cattle and other ruminants in India, and usually harmless. In severe parasitic outbreaks, however, they have been seen in such large numbers, occluding parts of the gut lower down, that they cannot have failed to cause serious disturbance, and sometimes sudden death.

Hydatids. Hydatid cysts, or the remains of these cysts, are discoverable in the internal organs of nearly all cattle in India. They are, as has already been said, a stage in the development of a certain dog tapeworm, and their frequency in India is undoubtedly associated with the large number of stray dogs in the country. They are seen in animals of any age, and are often very numerous in older animals. The cysts are most frequently seen in the liver and lungs. Sometimes the liver becomes greatly enlarged as the result of the invasion, and its functions impaired; or, sudden death may be caused by the pressure of a cyst upon an important blood vessel or large bile duct. Also, if a cyst forms in an important tissue such as the brain, fatal consequences ensue. Usually, however, the consequences of infection are slight. It may be said at once that nothing can be done to cure this infection, and prevention consists in giving animals water to drink that has not been soiled with dog excreta, in forbidding access of stray dogs to land on which cattle are kept, and prompt disposal, by burning or burial, of all carcases. (Gid in sheep is often operated upon, by extracting the contents of the brain cyst.)

It may here be mentioned that the identity of the worms invading the bowel can be readily determined by a trained man, by examining under the microscope small quantities of the dung for the presence of the specially shaped eggs of the various species.

PREVENTION. Sufficient has been said upon the nature of worm diseases to indicate the course preventive treatment should follow. Generally, good agricultural husbandry, with drainage and cleaning of

pasture land, is rewarded by a marked diminution in worm diseases; it is the best treatment for land that becomes "cattle-sick," "sheep-sick," or "horse-sick." Added to this, the measures also implied are those of crop rotation and stock rotation. Conversion into arable land or allowing the land to lie fallow for a year usually brings about the destruction of worm infection on a pasture. Again, the worm parasites of ruminants are not, for the most part, communicable to horses and other classes of animals; land that has become "cattle-sick" may therefore be cleaned by excluding cattle, sheep and goats from it for a year and putting horses on to it during that time. Unfortunately, when the land is again restocked with highly infected cattle it commences to regain its former sickness after a month's time. Overstocking of land is, naturally, a fruitful means of intensification of worm disease. Again, it has been explained that older animals are usually "carriers" of worms, without suffering from their ill-effects; young animals, on the other hand, are highly susceptible, and contract infection from pastures soiled by the adult animals. Hence, it is a sound general rule not to allow young stock to accompany older stock on pastures or follow them on such pastures; the land should be grazed over first by the youngest batches of stock, and later by batches of increasing age. It is difficult or well-nigh impossible, of course, to follow this precept with young stock still sucking their dams.

The application of lime and artificial manures to the land is a sound preventive measure. The fresh water snails that harbour the early stages of liver fluke are destroyed by dissolving copper sulphate, one part in a million, in the water that contains them.

A large body of stock-owners is still undoubtedly left without any economically practicable means of prevention after the enumeration of these rules. In fact, they are probably beyond the means of the vast majority of Indian stock-owners, and it is realised that more harm may be done, in abusing the confidence of owners, by urging impracticable measures than by omitting mention of them. Happily, our knowledge has so far advanced in recent years upon the subject of worm diseases of stock that no owner need feel despondent in respect of his capability to combat this class of disease with fair hope of success. Success resides in combining systematic, rational curative treatment to the largest extent possible with preventive treatment. In this chapter, the subject of prevention has therefore been dealt with first, to be followed by a short disquisition on curative treatment, so that the reader may gather the more readily the means of control at his disposal.

Treatment. Worm medicines have been employed in the treatment of human beings and animals since time immemorial; an immense number of plant preparations and chemicals have been tried,

more or less empirically, and with varying success. In recent years, our knowledge upon their efficacy has much advanced, through the systematic experiments of specialists directed to ascertaining the preparations which have the greatest destructive effect upon certain classes of worms and the least poisonous effect upon the patients. The result of this work has been that many of the familiar remedies have been discarded as almost worthless, that a few have proved promising, and that further work upon these and also on some new preparations have given us fairly precise information upon the best medicines for use in particular worm infections, of particular animals. Most of the preparations on the market are as worthless as they are harmless. To stand any considerable measure of success, the worms must be readily accessible to the action of the drug ; thus worms in the lumen of the stomach or intestine can often be easily destroyed by certain drugs taken by the mouth, while those embedded in the bowel wall or in the lungs cannot be reached in this way ; parasites in the liver can be reached sometimes, however, by certain drugs excreted with the bile from this organ. It is not proposed to give here a mere list of all the medicaments that have been advocated from time to time ; any medicines to obtain the favour of the stock-owner must be cheap and easily prepared and administered, as well as efficacious, and an understanding of the principles of treatment already given will serve a better purpose than will numerous prescriptions. For certain parasites, such as hookworm in man, we know that certain drugs, such as carbon tetrachloride or oil of wormseed, give the best results ; for certain other parasites, such as bots and ascarids in horses, we know that another drug, carbon bisulphide acts as the best remedy.

For the stomach and intestinal worms of ruminants, careful work in many parts of the world has shown that copper sulphate is the best drug for general use. We may discover later that there are superior drugs, and, indeed, recent work has shown that carbon tetrachloride is an excellent drug for use in sheep ; it is attended with certain dangers, however, particularly in cattle.

Copper sulphate does not always destroy all the parasites when used alone, and, to complete its action, specialised workers have recently combined it with other medicaments ; South African authorities have employed sodium arsenite, and certain American authorities have reported very favourably on tobacco.

A. *South African (Veglia's) mixture.*

(i) *Powder form*—

Copper sulphate (powdered)	4 parts.
Sodium arsenite „	1 part.

Mix thoroughly together. Dose for adult sheep, 10 grains, to be placed on the back of the tongue and repeated in 24 hours. Dose f calves to commence, presumably with 15 grains.

(ii) *Liquid form*—

Copper sulphate	50 grams.
Sodium arsenite	12·5 „
Concentrated hydrochloric acid (0·4%)	14 c.c.
Water . . . . . . to	1,000 c.c.

Dose for adult sheep, 10 c.c., administered conveniently by means of a syringe with a blunted nozzle and repeated in 24 hours. Dose for calves to commence presumably with 15 c.c.

B. *American (Guberlet's) mixture.*

Copper sulphate	1 part.
Tobacco	1 part.
Water	100 parts.

The tobacco, which may take the form of crude or powdered tobacco, is weighed out and allowed to steep in the water overnight; the copper sulphate is then dissolved in it. The dose for lambs is 50 c.c. (=1¾ ounces); for yearlings or older animals 100 c.c. (=3½ ounces); calves recommended 150 c.c. (=5 ounces); yearlings, 200 c.c. (=7 ounces) or more.

C. *Copper sulphate alone (Hutcheon's treatment).*

(i) *Liquid form*—

Copper sulphate	1 part.
Water	100 parts.

Dissolve. Doses as above, for Guberlet's mixture.

[(ii) *Solid form or "salt lick."*—

(Von Linden's), recommended particularly for lung worms.

Copper sulphate (pure)	1 part.
Common salt	100 parts.

To be given to older cattle daily for five to six weeks with their food; or, dissolved and given in milk or water, 10 grams (=about one-third ounce); calves, 5 grams (about one-sixth ounce).

The mixture may be compressed also into blocks, and given in the form of a "lick" to animals kept in open and which cannot be secured for individual treatment.

It is recommended that the daily treatment should continue for four to six weeks.]

Several simple devices have been described, such as spoons of various sizes (for powders), syringes, and automatic cylinders, for the rapid treatment of large numbers of animals with these medicines. Whenever professional aid is available, the stock-owner should summon it to his assistance for the administration of these remedies, but it is realised that in India he will often be thrown on his own resources in applying treatment of this kind. He should remember that animals which are very weak and far advanced in the disease are not very suitable subjects for treatment; they may even succumb to the effects of the treatment, and it is always wise to commence treatment upon a few animals to make sure that the medicine has been made up correctly and that the dose is not excessive. Animals that are in the early stages of disease and have not become much weakened give the best chances of cure. When an outbreak of worm disease is anticipated therefore, as when some animals show signs of the disease or when the season of the year during which worm disease usually occurs has commenced, the

treatment should be applied to all animals, particularly all the young animals, and it is profitable even to dose regularly in the same way the older ones, for they are assuredly " carriers " of infection ; in some forms of worm disease, such as the nodular worm disease, direct cure of the young affected animals is impossible (for, the disease is set up by young parasites in the gut nodules, that are inaccessible), and so the disease can only be controlled, by treatment of all animals, including the unaffected adults that harbour the egg-laying mature worms.

The treatment should be repeated afterwards once every month while the season lasts during which worm disease occurs ; where the disease occurs throughout the year it should be repeated indefinitely. This is most important, for after the initial cure, the young animals soon become infected again, from the contaminated pasture, but if the treatment is repeated (in a month's time) the new brood of parasites is killed in the bowels before it commences to lay eggs again.

It is probable that the simple copper sulphate or copper sulphate and tobacco treatments would be most suitable for Indian conditions.

A very successful method of curing liver rot has recently been devised. The liver flukes are not destroyed by the copper sulphate treatment. They, or at least the common kind, can, however, be destroyed by means of an extract of male fern. There are on the market some proprietary preparations of this remedy, but it has been found that the B. P. extract serves just as well and it is much less expensive. The animals are fasted overnight, and the following morning are dosed with the drug. The dose is repeated on three or four consecutive mornings. The size of each dose recommended is as follows :—yearlings, 2 to 4 drams ; two-year olds, 4 to 6 drams ; adults, 6 to 8 drams. Carbon tetrachloride serves equally well or even better for sheep and is much cheaper, but it seems to be too poisonous for use on cattle. Professional aid should be sought to commence this treatment.

For lungworms in calves (or lambs), various inhalations and injections into the windpipe have been extensively tried. It is claimed that the administration of chloroform into the nostrils (11 c.c. for calves), which are then stopped by the hand or with some cotton wool, until the animal staggers, is a good treatment. Good nursing, by itself, however, has been shown to be more likely to lead the affected animal to recovery than attempts to destroy the parasites in the air passages.

In all worm diseases, good nursing is most important in treatment.

Medicinal treatment of the kind described acts not merely as a curative for the affected animals, but also, by regularly destroying the parasites before they have time to reproduce themselves in the animals, it is also a most effective form of preventive treatment, and combined with the preventive measures already described, applied as far as practicable, it is the surest means of eradicating worm disease.

CHAPTER XIV.

COCCIDIOSIS.

NAMES.—Red dysentery of cattle. Hind.—*khuni-dast; Khuni-ishal.*

In recent years it has been proved that nearly all cattle in India harbour within their bowels extremely minute animal parasites known as coccidia. These parasites can be detected in the fæces as small oval, round, or egg-shaped bodies under the microscope; these small bodies are the result of the development and reproduction of other forms within the lining of the bowel; after they have been dropped on slightly moist ground or grass they pass through certain stages and in a few days are in a condition to infect other cattle that take them up with their food. Coccidia, of different species, affect other animals also, and in rabbits and fowls infection with these parasites causes grave outbreaks of disease. Horses are not infected. Cattle in India seem to get infected with the parasites soon after birth, and harbour infection subsequently throughout life, and, as a rule, show little or no outwardly visible disturbance as the result of the infection.

Sometimes, however, the infection is made manifest by the occurrence of distinct bowel disturbances. Usually, these are seen in younger animals under two years old, but it seems that in India they may be seen frequently also in older animals.

SYMPTOMS. As a rule, the disease commences with signs of diarrhœa, without any other symptoms; for a day or two, liquid, dark-green fæces of an offensive odour are evacuated involuntarily. Sometimes, however, the first symptom is abdominal straining, with the evacuation of fæces normal in consistence, covered on their surface with minute clots of blood; in a day or two, the fæces become soft in consistence. When diarrhœa has become established, the fæces are very soft to watery in consistence, contain a large admixture of slime, and often clots of blood of considerable size. The coccidia can be detected in large numbers in the slime. There is then loss of appetite, dulness, staring coat, and weakness in the hindquarters, with very little fever. In what may be called acute cases, these symptoms gradually progress in intensity until the animal dies in one or two weeks.

The symptoms vary greatly, however, in intensity from the "hyperacute" to the far more frequently observed "chronic" cases, which may be so mild as not to be suspected as specific disease conditions, even by an expert. The mortality in all observed cases of actual infection must be very low, probably less than five per cent. in uncomplicated cases.

The infection in India assumes a good deal of significance, not so much as a pure infection capable of producing disease by itself, but from the fact that it can be resuscitated from its ordinarily dormant state by intercurrent affection so as to set up severe or even fatal complications. Certain agents that have a depressant or irritant effect upon the lining of the bowel, such as croton oil, can thus awaken the coccidia into a state of considerable activity. The awakening is brought about, however, to a most conspicuous degree during an attack of cattle plague, which, as is known, produces serious damage to the lining of the bowel; this depressing action relaxes the control of the bowel on the rate of multiplication of parasites, which then invade the lining with destructive effect. Thus, in sub-acute cases of cattle plague, one may sometimes notice that when the animals seem to be on the road to recovery and diarrhœa has ceased, they suffer from an unexpected relapse with, again, diarrhœa, often tinged with blood, lose strength, lie down, and die.

Post-mortem APPEARANCES. The changes commence in the lining of the terminal portion of the bowel, known as the rectum, in the form of extremely minute ulcers, from which the bleeding takes place. These changes then extend in local intensity and spread forwards in the bowel. Often, change; of ny k nd are difficult to see with the unaided eye

TRE TM NT There is no specific treatment known, but the affected animals respond to good nursing—warmth (cover body with blankets if the animal is cold); soft food (gruels, mashes, good hay or grass). The diarrhœa may be checked by the administration of an astringent drench (7).

PREVENTION. It is difficult to recommend any practicable form of preventive treatment, seeing that cattle in India become almost inevitably infected. In areas where the affection appears often with a seasonal distribution, it is probable that the prevailing conditions favour massive infection. Avoidance of moist lands, where the parasites might be thought to find conditions favourable for development, might here be recommended, but, on the other hand, it is known that the cattle coccidium actually finds conditions best for development where the ground moisture is slight and not excessive.

CHAPTER XV.

EPHEMERAL FEVER.

NAMES.—Three-day sickness; Stiff sickness; Dengue. Hind.—*Vil; Bilho; Charmekh; Oochwali.*

This disease is an acute fever of all kinds of cattle, usually running its course in three days, and characterised by muscular sickness. It seems to be of common occurrence throughout North-Western India and the adjoining countries; it has been well described as it affects cattle in South and East Africa and Egypt. Cases have been seen also in the hills, up to an altitude of 6,000 feet (MEADOWS). It is seen most frequently during or shortly after the rains (July-October). It makes its appearance suddenly in a herd, and when it is first seen several animals may be attacked. The disease, however, is not contagious but appears to be transmitted by the agency of insects (night midges) in much the same manner as human dengue. The infection is present in the blood, and is a germ of the ultra-visible class. Outbreaks may be observed to occur at the same time in widely separated localities. The period of incubation is two to three days.

SYMPTOMS. The onset of the disease is sudden, and is shown by high fever (104-107° F.); the fever and other symptoms are seen within a few hours in an animal that was previously in quite normal health. The body is stiff, some animals lie down obstinately and refuse to rise, while others stand with their backs arched and their heads extended. One or more limbs are affected with lameness, which often moves from one limb to another in a very short time. Pulse and respiration are accelerated; loss of appetite; rumination ceases; usually, difficulty in swallowing; constipation generally, but there may be diarrhœa at the commencement of the disease. All these symptoms disappear at the same time, and recovery is usually complete by the fourth day. As a rule, only a small proportion—one-fifth or less of the animals in a herd are attacked. The symptoms, therefore, resemble those seen in the early stages of blackquarter, and the diarrhœa and the high fever seen at the commencement of the disease may lead one to suspect cattle plague. Deaths from the disease are very rare in untreated cases, and it is probable that most of the deaths that actually occur result from the attempts at treatment, when the drenches go down the wrong way and cause pneumonia.

Post-mortem APPEARANCES. Uncomplicated cases are rarely seen *post-mortem*, but the changes appear to be an altered condition of the blood, which clots very readily, with some effusion into the surrounding

tissues ; a quantity of blood-stained fluid in the pericardial sac ; a violent inflammation of the lining of the fourth stomach.

TREATMENT. In normal conditions, with rest, shade, water, soft fodder, and an absence of extreme heat and cold, deaths are very rare, and it is better to withhold all medicinal treatment. Drenching with Epsom salts (about ½ to 1 lb.) at the commencement of an attack has been recommended, and if it is carefully done its effects may be beneficial.

PREVENTION. Nothing definite is known about the preventive measures that should be employed. It has been found elsewhere that the immunity after attack is a short-lived one, lasting about six weeks, and the same animal may be attacked several times.

The disease, in reality, is deserving of mention only in so far as it may be mistaken for other, more serious diseases, and may tempt the stock-owner to adopt curative measures that will have but a harmful effect.

CHAPTER XVI.

SURRA.

NAME.—Trypanosomiasis. Hind.—*Surra ; Tinsala ; Zahrbad.*

Surra is seldom mentioned as a disease of cattle in India. They are generally supposed to be immune. In fact, the cattle, including buffaloes, of India are almost universally "carriers" of surra infection, which, as is well known, on gaining entry into more susceptible species, such as horses particularly, and, to a lesser extent, camels, causes a serious, and almost invariably fatal disease—one of the most serious diseases of these animals in India. Surra is caused by a very small, whip-shaped animal parasite, known as a trypanosome, wh ch multiplies in the blood of infected animals. When the parasites are present in the blood in considerable numbers, the affected animal shows high fever, dulness, hair on end, loss of appetite, sometimes eruptions under the skin, and discharge from the eyes Usually, the multiplication of the parasites is then temporarily diminished, and the symptoms abate, to recur later with their former intensity after an interval of a few days or a few weeks. After a succession of recurrent attacks, the animal shows progressive anæmia, wasting, dropsy under the belly, and finally succumbs, sometimes after showing distinct nervous symptoms. It is only rarely that infection sets up a train of symptoms resembling these in cattle. When they become infected—as is the rule, by the bites of certain blood-sucking flies, carrying the parasites with the blood of an animal already infected—the resulting affection is usually so mild as to pass unnoticed; yet, if the blood of the cattle so infected be examined afterwards, very small numbers of parasites will be found from time to time for an almost indefinite period. Sometimes, these parasites may become resuscitated in activity when the animal's resistance is depressed, from some intercurrent affection, such as cattle plague. However, the parasites ordinarily may be said to have established a state of equilibrium with the animal's tissues ; it can be proved that they still retain their full virulence for susceptible animals, such as horses,and so the cattle of India represent a dangerous reservoir of surra infection for these animals.

Occasionally, virulent outbreaks of surra occur, nevertheless, among cattle, and more especially buffaloes. Buffaloes appear to be somewhat more susceptible than are other cattle, and in outbreaks a large proportion of the herd may become affected and the mortality rate among them rise to fifty per cent., or even much higher. Usually, the progress of the disease is then very rapid, and the animals die after a few recurrences of fever. The symptoms are as described above. In

some outbreaks among cattle in India, brain symptoms are very marked. Outbreaks among cattle appear to be more common than is usually supposed, and they are believed to occur with special frequency in forest areas. The incubation period is short—four to eight days. The disease can be diagnosed definitely only by examination of the blood under the micros cope, and so when a number of cattle in a herd become affected with a progressive or recurrent fever, professional aid should be called to diagnose the affection accurately.

TREATMENT. Outbreaks of surra in cattle, including buffaloes, are easily cured. In the more susceptible animals cure is, as is well known, extremely difficult. It is sufficient to inject into the blood-stream of the affected animals a solution of tartar-emetic to bring about a rapid recovery. (The dose is up to 5 c. c. of a 3 per cent. solution for every 100 lb. body weight.) One injection is often sufficient, but sometimes the animals relapse afterwards, when a repetition of the treatment usually suffices to produce an apparently complete cure. It is known, however, that the parasites remain thereafter in the blood in a state of latent activity.

PREVENTION. The affection in cattle seems to be brought about by infection with parasites of exceptionally high virulence for these animals. When an outbreak occurs, therefore, all cattle showing commencing signs of the disease should be isolated immediately at a distance of several hundred yards from the healthy cattle, so that there is no chance of biting flies carrying infection across from the diseased to the healthy animals. This disease is here discussed at what may seem to be inordinate length, considering the importance usually attached to it in India, for the reason that when the stock-owner suspects its occurrence he should not neglect to call in professional aid to confirm his suspicions and administer promptly the neces. ary treatment.

CHAPTER XVII.

RABIES.

NAMES.—Hydrophobia. Hind.—*Pagala-pan ; Divangi ; Halka.*

In a country like India where rabies in dogs is of common occurrence, it is to be expected that occasional cases of rabies should be seen in other animals, including cattle and buffaloes. As it is with human beings, rabies is communicated to cattle most frequently by the bites of rabid dogs, and, less frequently, by the bites of jackals and other animals. The infection, which seems to be an ultravisible virus, is found in the saliva of the affected animal and is thus introduced under the skin with the bite. In other countries, remarkably large outbreaks of rabies in cattle have been reported from time to time, and in Brazil some years ago a large outbreak in which several thousand cattle and horses died of rabies was found to be transmitted by the bites of field mice. In these countries, methods of protective vaccination of cattle have been actively exploited. The period of incubation in rabies varies considerably, depending upon the amount of virus introduced, and the seat and extent of the bite; the nearer the brain, the shorter will be, as a rule, the incubation period. With light bites of the extremities symptoms of rabies may never develop; it has been estimated that about 50 per cent. of cattle bitten by rabid animals develop rabies. The incubation period in cattle is, as a rule, from one to three months. Exceptionally, it may be as short as a fortnight, and, on the other hand, it may extend to several months, or even one or two years.

SYMPTOMS. The symptoms are either those of great excitement or those of steady depression. In the former type, the beast shows signs of uneasiness, excitability, aggressiveness, and often great sexual excitement. In the open, it stands with raised head, curled upper lip, then tears up the ground with its horns and feet, and seizes upon cattle or other living beings in its vicinity. If it is kept indoors, it tries to break loose from its fastenings, jumps with its forefeet on the manger, and butts against the wall with such violence that it often breaks its horns. It often tears its own body badly. Usually, it emits a low, penetrating, drawn-out noise from the throat; salivates profusely; finds difficulty in swallowing, and is off its feed; has first constipation, and then diarrhœa; then lies down and gets up frequently; finally, loses power in the hind quarters and dies in from three to six days.

In the quiet form, there is very little or no excitement; the animal becomes affected with marked tympany; difficulty in swallowing; weakness in the hind quarters, and bent back. It stumbles readily

on walking, struggles with its feet, and discharges thick saliva from its mouth. It then rises : emits a plaintive bellow ; refuses food and drink, or else takes a little and bolts it out again. Later, it lies down on its breast or with its head turned back on its shoulder and grunts or moans. Death usually occurs within a week.

TREATMENT. Death is almost inevitable when once symptoms develop, and so treatment is of no avail. Care should be taken to prevent the affected animal from being a source of danger to other animals or human beings. Preventive vaccination has been tried in some countries, but the method of applying it and its efficacy are not definitely established yet.

A question that is sometimes asked is, is it safe to drink the milk of a cow that has been bitten by a dog suspected to be rabid ? It seems that the milk can be drunk with impunity, for litters of healthy puppies, at any rate, have been reared on bitches known to be in the incubation period of the disease. Moreover, the disease is not transmissible by ingestion. In any case, material containing the virus can be rendered quite safe by boiling. However, the owner will probably be guided in this matter rather by an instinctive horror of the disease than by what is known upon the extreme improbability of infection.

CHAPTER XVIII.

INFLAMMATION OF THE UDDER.

NAMES.—Mammitis; Mastitis; Garget. Hind.—*Sozish hawana; Thanpakka; Thanphula.*

Inflammation of the udder is a very common disease among cows, including buffalo cows, in India. It usually occurs sporadically, that is, one cow and seldom more, is seen affected at one time in a herd. Sometimes, however, several cases may be seen, and in other countries the condition may be seen to spread in a herd of cows like a contagious disease.

Nearly all kinds of udder inflammation are caused by the entrance, usually through the teat canal, into the udder, of certain infective germs. In local outbreaks of the disease, the germ is of a certain kind (a so-called streptococcus, usually), and in the sporadic cases, it is commonly of another kind (a so-called diphtheroid bacillus), which is an extremely frequent cause of all kinds of wound infection (*Bacillus pyogenes*) in cattle, and notably buffaloes, in India. Other kinds of germs may also gain entrance, and set up inflammation, but in the sporadic cases it is of interest to remember that they are of the same kinds as are found in ordinary wounds of cattle. In Europe, a chronic inflammation of the udder is commonly caused by tuberculosis spreading to the udder from other parts of the body; this condition is fortunately very rare in India.

The methods whereby infection gains entrance into the udder are not always clear. In the contagious forms, the specific germ of infection has developed the property of readily entering the udder, and so can be readily spread by the hands of milkers, contaminated floors, and other means. In the sporadic cases, it is often difficult to understand how the infection has got in. We know that germs of the kind found in the inflamed tissue are normally found in abundance around the teat, and often in fairly considerable numbers inside the teat canal. They will be particularly abundant on chapped, bruised, or injured teats, especially when the sores or bruises are left dirty and neglected after the act of milking. Overstocking of the udder, as when the cow is not milked for some time prior to sale, is also likely to render the entrance of infection easy, and to diminish the capacity of the udder tissue for resistance. The resistance of the udder is also depressed, and the entry of infection directly effected sometimes, by gross injuries, such as horning, blows, or kicks on the udder surface; in India it would seem that the most frequent cause of the disease is, indeed, goring of the udder by other animals, and this form of injury is especially frequent in the buffaloes.

Cold has sometimes been blamed, and probably damp floors in draughty buildings, contribute sometimes to the depression requisite for the entrance of infection.

SYMPTOMS. The symptoms exhibited by cows suffering from inflamed udder vary a good deal in intensity. According to its severity, the inflammation may be described as acute, sub-acute, or chronic.

Acute inflammation is more commonly seen within a month after calving, especially after first calvings, than at any other time; it usually appears quite suddenly and attention is often first drawn to it by the cow showing symptoms of high fever and other constitutional disturbances. The animal stands with hair on end, straddling and restless; breathing short and quick; appetite lost and rumination suspended. The disease, as a rule, is then noticed to have affected one quarter of the udder, which is red and then purplish, tense, and extremely painful to the touch. Sometimes, the inflammation progresses so rapidly that the animal dies within a few days. More often, the animal survives, and abscesses are formed in the diseased tissue, and although the affected quarter is destroyed, the return to health of the animal is accomplished with a restoration in activity of healthy quarters, which may function normally at the next lactation. In these cases, the secretion drawn off at first is very scanty and yellowish, and then blood-stained and offensive in odour; later it looks like the contents of an abscess. In cases that terminate fatally, the inflamed quarter may undergo extensive mortification (gangrene) before death. Sometimes, the disease invades a second or third quarter. In cases that survive, the affected quarter or quarters continue to secrete thick yellow material for a time, but later dry up, and become shrivelled.

Cases are considered sub-acute when the constitutional disturbances are not very distinct, the inflammation is mild and is inclined to subside early, and the milk secretion is not greatly reduced. This kind of inflammation may appear at any time during the lactation. The milk at first is not much altered in colour, but small clots are seen in it; later it loses whiteness and consists of yellowish whey with suspended curds. Pain and swelling of the affected quarter become increased. This type of inflammation, however, is amenable to proper treatment at its various stages; the symptoms then abate, and the affected part continues to function, to a diminished degree, depending upon the extent of the damage it has undergone.

Chronic cases are not uncommonly the after results of an acute attack. Often, however, they are cases in which the symptoms develop very slowly, with little or no constitutional disturbance. Then, one or several nodules are detected in the udder tissue at the base of the teat, which increase in size and number. The milk is at first normal in appearance, though decreased in quantity; it does not keep well, and clots form

in it on standing. Sometimes, the inflammation becomes accentuated with the conversion of the nodules into abscesses, which burst externally or into the milk ducts. In other cases, the affected tissue remains hard until the cow goes dry, when healing and shrinking of the diseased part takes place, with reduction in the future milk yield dependent upon the degree of destruction of the tissue.

TREATMENT. Acute cases are difficult to influence with any form of treatment; sub-acute cases are more amenable to treatment. The affected animal should be isolated and placed in clean surroundings. To remedy the constitutional disturbances, treatment should be commenced with the administration of a purgative (1), followed by stimulants (3); if, however, pain is very intense, a narcotic draught (9) should be given instead of stimulants. Small doses of purgative medicine should then be administered daily while the fever lasts. The diet should be sparing and composed of light, appetising food (grass, good hay, gruel), to diminish the strain in the udder, by decreasing lactation.

If there are visible wounds on the surface of the udder, they should be treated immediately in the manner described in the Chapter on "Wounds"; care should be taken to exclude the formation of maggots in the wounds, and for this purpose it is advisable to apply to them frequently a mixture of oil and turpentine.

Local pain is then relieved by frequently repeated hot fomentations of the udder and gentle massage. Poultices of linseed, bran, or other heat-retaining material, are often employed, and if changed often they have the same effect as the hot water fomentations. Great care should be exercised to see that these applications are not too hot. Liniments or embrocations, mustard and water, and ointments containing camphor, opium or belladonna also fnd favour when applied in the early stages. The milk should be drawn off frequently; the affected quarter should be milked last, into a special pail containing some disinfectant, and burned or buried. The produce from the apparently unaffected quarters may be consumed, if it is not visibly altered, after it has been boiled. The use of so-called teat syphons is not ordinarily recommended, as they are dangerous transmitters of infection. When abscesses develop, they should be opened up carefully, and washed out with antiseptic lotion (12). When gangrene occurs, and is of limited extent, it is well to wait the spontaneous detachment of the part, assisting the process by frequent applications of warm antiseptic lotion. Professional assistance should be summoned, whenever available, to deal with these cases.

Chronic cases are not much influenced by any form of treatment. Applications of iodine ointment are often recommended.

PREVENTION.—This is very important, and resolves itself into measures implying scrupulous cleanliness. Some of the germs of wound infection and udder inflammation (the so-called *Bacillus pyogenes*)

multiply in India at a prodigious rate outside the body in any animal discharge, such as the fluid from running sores or spilt milk. The animals themselves should therefore be kept clean, and the stables or other surroundings in which they are kept should be clean, well-aired, and dry. Great care should be taken not to admit into the stable in which other cattle are kept any newly purchased cow until it has been ascertained, during an observation period of about ten days, that she is not suffering from any progressive or latent disease of the udder. Cows suffering from diseased udders should have separate attendants, as far as possible.

Other diseases of the udder. Besides inflammation of the udder tissue, one may notice a number of diseases affecting the udder. Cow-pox and foot-and-mouth disease have already been described, in the way that they affect the udder. The skin over the udder also sometimes becomes affected with an infectious rash (*folliculitis*), which is caused by a specific germ (staphylococcus), like " barber's itch," and is conveyed from cow to cow by soiled litter or cloths used for wiping the udder. Then, there is an infectious pimply condition (impetigo) which affects the teats and lower parts of the udder, caused by a specific germ (a streptococcus), and is conveyed by the hands of milkers. These affections are to be controlled by the adoption of preventive measures.

Sore teats are very troublesome when they occur. The sores are caused by infection, injury, and, most frequently, by the development of chaps or fissures, which are rather likely to occur in young and thin-skinned animals. Cows suckling calves affected with " thrush of the mouth " often have sore teats. The condition is most common during the wet season of the year. Treatment consists in cleanliness, drying the teats after milking, and then smearing them with some mild ointment (such as zinc or boric ointment). When the fissures are deep, the teats should be washed, after milking carefully, with an antiseptic lotion (15) and then covered with ointment or dusted over with an antiseptic powder (18).

CHAPTER XIX.

MILK FEVER.

NAMES.—Parturient Fever; Parturient Apoplexy. Hind.—*Zichighi-ka-Bukhar.*

Milk fever is a common disease of heavy-milking herds, but is very uncommon among low-yielding cows that are kept in the open and suckle their progeny. Hence, it is a disease that is relatively rare, but by no means unknown, in India,* though it is a cause of much anxiety to cattle-owners in Western countries. The disease has also been reported among heavy-milking goats.

SYMPTOMS. The disease arises only after an easy calving, and usually very soon—within three days—after calving. Exceptionally, however, it may arise up to seven or eight days after calving, and, sometimes, within 24 hours before calving. The cow appears uneasy, moans, and staggers or sways on its hind legs; occasionally there are muscular spasms; the pupils of the eyes are dilated; sometimes, the symptoms develop so quickly that the cow just drops down. She then tries to rise, sometimes succeeding a number of times, and loses consciousness. The cow lies down on her breast, with her head turned round usually on her chest, but, not infrequently, stretched out on the ground; she is rarely very violent. If she remains in this position for some time marked tympany occurs, which may soon become so intense that she dies of suffocation. Breathing is usually deep and slow; pulse accelerated and feeble; body surface and extremities cold; there is, as a rule, very little rise of temperature, and towards the end, the temperature is decidedly sub-normal.

Mild cases may recover spontaneously; the more commonly observed acute cases last, as a rule, from one to three days; if the coma lasts longer than three days recovery seldom takes place. When recovery does take place, it is remarkably sudden and complete. A disturbing sequel to milk fever sometimes is a condition of permanent paralysis of the hind quarters.

Milk fever should not be confused with, (i) a simple condition of debility after calving, when the cow prefers to lie down; (ii) true

*Mr. W. Smith, the Imperial Dairy Expert, informs me that he can recollect about twelve well-authenticated cases among Indian cows in his 21 years' experience. A typical case, that ended fatally, occurred in a Thar-Parkar cow at Karnal in 1926; this cow was "an extraordinary heavy milker", and gave over 30 lb. of colostrum on the day she calved. Further, "it is the very best of our stock that contract this disease".

I am much obliged to him for the information that the disease is "by no means unknown" among pure Indian cows, and for his advice to insert this note upon it.

apoplexy, apparently a brain disease, in which the animal shows signs of much greater violence; (iii) a condition that comes on usually later after calving through septic infection of the womb.*

TREATMENT. The successful treatment of milk fever was known, curiously, many years before the cause of the disease was understood. It consists in distending the udder with air or other gas or some mild antiseptic fluid as soon as possible after symptoms are noticed. We now know that this treatment succeeds by causing the udder tissues temporarily to cease functioning, and so give time for the blood sugar to be re-established. Whenever possible, professional aid should be sought at once to administer the treatment. However, with heavy milking herds, where veterinary aid is not always available, the owner or manager ought to procure the simple apparatus necessary for the treatment and practise its use. The apparatus consists of a teat syphon —a simple tube about three or four inches long, preferably of silver (purchasable from veterinary instrument makers), that can be readily introduced into the teat canal; immediately before use, this tube should always be carefully sterilised by boiling for a few minutes. The outer end is then connected by means of a piece of india-rubber tubing with a clean bicycle pump, and air is steadily pumped into the quarter until it becomes firm and hard. A piece of tape is then tied round the teat to prevent the escape of gas. The remaining three quarters are treated in the same way. As a rule, the cow is on her feet in about an hour after this treatment, if it has been applied early in the course of the disease. The udder should not be emptied for about twelve hours afterwards; small amounts of milk should then be drawn away several times daily for two or three days, and the animal given a res-

*The cause of this well-known disease has only been determined within the last few months. The milk of the cow contains, as one of its solid constituents, a certain quantity of milk sugar, or lactose (about four and a half per cent.). The sugar is derived, by the action of the udder tissue, from the sugar (glucose) of the blood, which contains a minute (0·1 to 0·2 per cent.), but very constant, quantity of this sugar in solution; the blood sugar is the chief source of fuel or energy of the body tissues in general, and it is kept at a constant level by the action of a peculiar so-called internal secretion of the pancreas known as insulin. When the blood sugar is not controlled, through some disturbance of the pancreas resulting in the cessation of the supply of insulin, the excess is secreted by the kidneys with the urine, and the patient suffers from what is called diabetes; this, as is well known, is a common disease in man. Diabetes in man is now often treated by repeated artificial injections of insulin (derived from the pancreas of cattle). If an excess of insulin is accidentally administered, and the blood sugar becomes thereby reduced much below its normal level (so-called hypoglycæmia), the patient suddenly develops symptoms of unconsciousness (coma), and paralysis, of the same kind as is seen in a cow suffering from milk fever. The attack may readily end fatally; if, however, the patient is given at once a quantity of sugar (glucose), to restore the blood sugar to the normal level, he quickly recovers. The natural disease known as milk fever in the cow is also a hypoglycæmia. In the heavy-milking cow, the udder, just before or just after the act of calving, commences suddenly to draw upon the blood sugar at a great rate; the sudden depression in the blood sugar level may thus bring about at once symptoms of grave coma and paralysis, and the animal probably succumb, before the internal organs get accustomed to regulating the reserves of blood sugar to meet the demands of the udder.

stricted diet and gentle exercise. Medicines should be strictly avoided while the cow is suffering from the acute symptoms, for they are then very likely to pass down the windpipe and set up pneumonia. (It is not unlikely that in future years professional men will resort to injecting glucose into the veins as a rapid treatment for this disease.)

PREVENTION. The risk of the disease can be much reduced by keeping the cow on a low diet for several days or weeks before calving. Where experience has shown that there is an appreciable risk, the apparatus for treatment should be kept always readily available for immediate use, so that an affected cow can be treated at the earliest possible moment after showing symptoms.

CHAPTER XX.

COUGH.

NAMES.—Hind.—*Khansi ; Dhans ; Khes.*

The familiar symptom known as cough is produced by sudden reflex explosive separation of the vocal cords in the throat after a forcible contraction, and it has for its object the expulsion of irritating material accumulated in the throat or lower down the windpipe or within the chest ; sometimes, it arises reflexly also from irritation in the belly or elsewhere in the body. It varies considerably, as is well known, in frequency, tone, pitch, echo ; sometimes the cough is described as moist, when there is a good deal of mucus or phlegm in throat, and sometimes as dry, when the throat is not moist. The cough may be so frequent as to occur in what are called paroxysms. These varieties of cough are well known to all observers. The cough may be only one of several symptoms exhibited by the animal. It is a symptom of disease, and the other symptoms that accompany it will usually indicate the kind of disease from which the animal suffers. It is most frequently a sign of disorder in the throat, and when it is accompanied by an increased rate of breathing and discharges, usually from the nose, the disorder has spread lower down to the windpipe and small air passages of the lungs (bronchitis) ; again, a very painful cough accompanies pleurisy (inflammation of the lining of the chest). In these more serious disorders, there is also fever, varying in degree, with dulness, hair standing on end. Inflammation of the lungs (pneumonia), which often ends fatally, usually commences as bronchitis in cattle. Chronic cough among cattle in Europe is always a suspicious sign of tuberculosis, fortunately rare in India. In some other countries, it is also indicative of a specific contagious disease (contagious bovine pleuro-pneumonia), which spreads insidiously and causes grave losses among herds of cattle.

Simple cough may be set up by a number of causes : foreign bodies lodged in the throat (*see* Choking) ; dust particles, especially wind-blown dust, as in dust storms, or dust raised in dry weather on roads, or from dusty, mouldy, or otherwise spoilt fodder, and especially when accompanied with thirst ; irritant gases, as from decomposing manure in badly-ventilated sheds. Worm parasites (*see* chapter on Worm Diseases) are frequently the causes of outbreaks of bronchitis, accompanied by a peculiar, husky cough, in younger animals. Colds and chills are known to be inciting causes of chest affections, especially when accompanied with fatigue or overwork, bad housing, and under nutrition. When the cough arises through sore throat, it can be excited by pressing the animal's throat, or placing some obstruction over the nostrils.

In deeper chest affections (bronchitis and pneumonia) the cough is at first dry and painful, and later becomes softer and moist ; it is usually accompanied with discharges from the nose and mouth ; the nature of the trouble in the chest can be diagnosed by tapping the chest and listening to the sounds in the chest by applying the ear to the chest wall.

TREATMENT. Treatment will depend upon the cause of the cough and the other symptoms accompanying the cough, which may require more urgent treatment than the cough itself. In any case, the animal should be kept in a clean, cool, well-ventilated place, free from dust, and be given soft, wet food, or succulent grass while the symptom lasts. Dusty or mouldy fodder should not be placed near the animal.

If the throat is distinctly affected, an embrocation (20) should be rubbed into the underlying skin or mustard made into a thick paste with water applied. It is also a good plan to steam the animal's head, by holding the nose over a bucket of very hot or boiling water, on to the surface of which a few drops of turpentine or eucalyptus oil have been poured ; the steaming is better done when a sack is placed over the animal's head to come over the bucket.

When the chest is affected, extra care should be taken about the maintenance of the animal—good nursing, soft food, fresh air (day and night). Embrocation or mustard may be applied to both sides of the chest, and the steaming repeated every few hours. Stimulants (3 or 4), followed by tonics (5), when the animal is convalescent are often recommended, but the greatest care should be exercised in drenching an animal affected with respiratory trouble : much more harm than good is done very often, especially when the material goes down the windpipe. In fact, the most important factor in the treatment of all chest complaints is good nursing.

The treatment for the type of bronchitis caused by worm parasites has been described in a preceding chapter.

PREVENTION. What has already been said concerning the origin of coughs, and chest complaints generally, will enable the reader to devise means of prevention.

SNORING.

Snoring, unaccompanied with other distinct symptoms except some discharges from the nose, is not uncommon among cattle in India. Usually, it is caused by the presence of leeches in the nasal passages. The Indian cattle attendant is often adept at the removal of these parasites.

In many districts throughout India there occurs also a peculiar enzootic disease, characterised by the presence of wart-like excrescences on the nasal mucous membrane. The disease is strictly localised to this

membrane, and the diseased tissue shows changes exactly similar to those seen in the common cattle disease of Western countries known as actinomycosis, or " wooden tongue," or " lumpy jaw."* " Snoring disease," as it is called, (or, sometimes, infectious nasal granuloma) seldom causes any serious disturbance to the animal, except at work, when it may affect the breathing considerably. It is a very insidious disease and may last many years in the animal. It is not unlikely that it is conveyed by the nose string sometimes. It can be successfully treated, it seems, by repeated injection, at weekly intervals, with tartar emetic, in increasing doses ; this should be done by a professional man.

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* It is often understood that actinomycosis, of the kind frequently seen in cattle in Europe, does not occur in India. Major P. B. Riley, Deputy Director, Civil Veterinary Department, Bihar and Orissa, has recently communicated to me, however, that although infectious nasal granuloma is fairly common in India, true actinomycosis is the more common affection in North Bihar. He also mentions, to illustrate the varying distribution of disease, that blackquarter does not affect cattle in South Bihar, whereas it is at times widespread in North Bihar.

CHAPTER XXI.

CHOKING.

NAMES.—Hind.—*Gale ki rok ; Rokhgalla.*

Choking is a rather common accident in cattle, caused by sudden obstruction of the throat or gullet with food material or foreign bodies. It is a habit with some cattle, especially buffaloes, to chew food with their heads raised and necks outstretched, and it may happen in this way that lumps of hard material eaten slip down, particularly when the animals are unexpectedly disturbed, into the throat without proper mastication. Hard, bulky masses of unusual food, such as certain fruits, roots, or pieces of sugarcane, may thus cause obstruction. Also, it is well known that cattle often show a depraved or indiscriminating taste for strange objects (foreign bodies), such as bones, rags, afterbirth, pieces of leather, wood, wire, nails, or tins. An object of this kind, placidly chewed for some time, may get beyond control and pass accidently into the throat when the animal is disturbed. Rarely, the obstruction is caused by a foreign body, such as a hair ball, passed up into the gullet during rumination. In cattle, the obstruction takes place most often either at the entrance to the gullet or at the upper part of the gullet, and in this situation it can often be seen as a hard swelling in the furrow on the left side of the neck.

SYMPTOMS. The animal stops feeding, becomes uneasy, and shows an anxious expression. The movements of the head and neck show that it is trying to swallow forcibly, with mouth often open, and tongue hanging out. It gasps, often tries to vomit, and salivates profusely, and sometimes emits a most painful cough.

A notable feature is the quick distention of the stomach with gas (tympany), caused by the failure of the normal eructation of gases. Sometimes, when the obstruction is not very tight, the wind forces its way up after a time, to distend the stomach again later. In some cases, depending largely upon the fermentable nature of the stomach contents, the tympany produces such distressing effects upon the heart and breathing that it has to be relieved at once or else the animal dies.

Again, when there is a large obstruction in the throat or top of the gullet, the pressure in the entrance to the windpipe may be so great that the animal runs a danger of rapid suffocation, and unless the obstruction is quickly removed or tracheotomy performed, the animal dies.

When the obstruction is lower down in the gullet, the symptoms are not so distressing, and it is not so easy to detect the complaint.

However, after having taken a few mouthfuls of food or water, they are returned by the animal through the mouth or nostrils, and this observation should lead one to suspect the place of obstruction.

Sharp bodies, such as nails, tend to perforate the wall of the gullet and cause a rapid, painful inflammation of the surrounding tissues.

TREATMENT. Treatment will depend largely upon the urgency of the symptoms. If tympany or suffocation is so acute as to be thought likely to endanger quickly the animal's life, first aid treatment should be resorted to at once to relieve them. In cases of acute tympany, the stomach should be punctured unhesitatingly (*see* succeeding chapter), so as to allow the gases to escape, and the hole made kept perforate, or open, until the obstruction has been passed; in very many cases, the animal will then recover in the course of a short time, and nothing further need be attempted. In cases where there is danger of suffocation, an attempt should also be made at once to extract the obstacle through the mouth; this can often be done fairly readily when it is lodged in the throat or can be felt blocking the upper part of the gullet. A good gag should be used to keep the mouth open, or, failing a proper gag, a large stirrup iron may be used. The head is then steadied by two or more men, while the person who is trying to remove the obstruction holds the tongue with the aid of a cloth with one hand and explores the throat with the other hand. Some animals resent this handling very much and if the symptoms are urgent, it is better to open up a small hole in the windpipe (tracheotomy) about half way down the neck.

At one time, the treatment almost always adopted whenever obstruction was suspected, was to pass a long tube (a probang) down the gullet to force down the obstacle. This procedure is not now recommended, unless the choking symptoms persist for some time, after attention has been paid to the urgent symptoms. The wall of the gullet is quite delicate, and serious risks are run when an attempt is made to drive down with force an obstacle that will not pass down readily, and often damage is caused by rough passing of the probang itself. What is recommended, on the other hand, after the acute symptoms have been relieved, and removal by hand of the obstacle is impossible, is to give the animal small drinks of tepid water or small doses of oil, to soften the material. Very often, after a short interval, it then passes down.

When the obstruction persists, the passage of a probang may be tried, and if this instrument is not procurable, a smooth, supple cane, about six feet long, and about the thickness of a finger, will answer the same purpose. (What is better than a cane alone is a length of rubber hose-pipe, inside which is placed the smooth, supple cane.) To one end should be securely tied a soft pad of cloth or cotton wool, not bigger than a small hen's egg. The whole cane should be well oiled before use. The mouth of the animal is held open by

The belly quickly becomes bloated; the swelling outwards is especially noticeable in the left flank, and may extend upwards to a higher level than the spine. A sound as of a drum is emitted on tapping the distended flank, which becomes tighter and tighter. If one listens with the ear to the flank a few gurgling noises are heard, when the gas remains above the solid contents, or a continuous crackling or surging noise, when the contents fill the paunch and are mixed up with gas bubbles. Later, the animal grunts or moans, and breathes with difficulty; lies down, and has to get up; champs, salivates, and gasps with hanging tongue; sometimes vomiting occurs—a good sign; or the eyes become blood-shot, and the animal falls from its feet suffocated. The symptoms may commence while the animal is still grazing and it may be dead in half an hour after they are first seen. They may last longer—an hour or two, and sometimes belching up of gases then commences and the animal gradually recovers.

TREATMENT. Sometimes, when the animal is in great distress, immediate puncture of the flank is called for, and the stock-owner who has had experience of tympany among his cattle is advised to get himself practised in this simple first-aid operation. It is better to have a special instrument, called a trocar and cannula, for this purpose, but, failing this, a sharp knife may be used, which should be plunged sharply into the most distended part of the left flank, making a cut about an inch or two in width. The gases or frothy liquid contents will then escape violently. The correct place for the puncture may be estimated as a point at equal distances from the last rib, the point of the haunch, and the edge of the loins. As soon as the hole is made, a length of hollow bamboo or piping about six inches to a foot long and about one inch in diameter—should be inserted into it, before the stomach wall falls away from the flank, so that the gases can continue to escape through this tube. The tube ought to be kept in this position for several hours, and its outer end tied securely with a piece of string around the belly so that it runs no danger of slipping into the stomach. It is then withdrawn, and the edges of the wound kept carefully clean.

When the animal is seen early, however, and its condition is not so distressing, the best plan is to keep it actively moving, so that the gas may be belched up. This is much aided by placing at once inside the animal's mouth a block of wood which is kept in position by means of a cord tied round the horns. At the same time, the flanks are kneaded, forcibly rubbed and massaged; a good plan is also to pour quantities of cold water on them. If belching of gases does not commence in this way, after some time, an attempt may be made to pass a probang or gullet stick as described in the preceding chapter on Choking. It is seldom that gases escape through the probang, but on its withdrawal a quantity of liquid stomach contents may come up, and the gases follow.

The operation is not without danger, for the amount of liquid that comes up is sometimes enough to drown the animal at once, when it gets into the windpipe, and even if it enters in small quantity it may later cause pneumonia.

It is not now considered that medicines are of any use in acute tympany. After the animal has recovered, it should be kept for some days on gruels and dry food until it regains its usual appearance.

CHRONIC TYMPANY.

The causes of chronic tympany are various, and it is a frequent accompaniment of indigestion in cattle (*see* succeeding chapter). Any condition which interferes for some time with the normal belching up of gases from the fermenting food of the first stomach brings it about: continued bad feeding; dirty food, resulting in accumulations of sand or earth in the stomach; certain poisonous plants; atony or debility of the stomach wall, after recovering from serious diseases; parasites in the bowels, injury caused by foreign bodies (frequently); obstruction in the gullet, caused by enlarged glands or tumours. There is often some degree of peritonitis when there is injury to the stomach.

SYMPTOMS. Chronic tympany is easily recognised by the persistent swelling high up in the left flank. It is often more distinct just after a meal, though during feeding the animal may be somewhat relieved by the passage upwards of gases with the opening of the gullet. After a time, the animal loses condition, its appetite fails and often becomes depraved.

TREATMENT. Often very unsatisfactory, and the relief given is frequently only temporary. The chances of recovery depend largely upon the cause of the disease. They are small when there is gross injury to the bowels, caused by a foreign body. In any case, an attempt should first be made to discover the cause—whether it is just bad, irregular or dirty feeding, or something more remote. The diet should be restored to light good feeding, and clean water given to drink. Medicinal treatment may be commenced by giving a purge (1 or 2), or a mixture of turpentine and linseed oil (10), as a drench, carefully. Common salt should then be mixed with the food daily in quantities sufficient to keep the bowels open. If it is difficult to drench the animal with a purge, a mixture of equal parts of common salt and treacle may first be rubbed on the tongue with a wooden spoon; this will induce thirst, and afterwards four ounces or more of common salt can be put each time in the animal's drinking water, and the quantity varied in amount from time to time so that the bowels are kept open to the required degree. Any of the several good stimulant, tonic or so-called alterative medicines may then be given with advantage daily with the food or as a drench (such as 3, 4, 5, 6, or 11). If the disease is such that

it is amenable to any form of treatment, however,—and many cases cannot be influenced favourably for long by any treatment—the most important consideration is attention to the food and drink, aided somewhat by keeping the bowels open by some simple medicine, such as common salt.

The professional man should be called in when available; sometimes much benefit accrues from a surgical operation ("incomplete rumenotomy") on the belly. (See page 99).

CHAPTER XXIII.

CHRONIC INDIGESTION.

Names.—Atony of the first stomach ; Impaction of rumen or of the omasum ; "Dyspepsia" ; Chronic gastritis ; Chronic gastro-enteritis. Hind.—*Badhazmi*.

It is convenient to describe under the name chronic indigestion a very common ailment of cattle which is caused by bad feeding or by some diseases of the stomachs or other internal disease, and in which the stomachs fail through inability or weakness (atony) to discharge their contents. The food then stagnates in the first (rumen) and third (omasum) stomachs, which are then said to be impacted.*

The disorder is seen mostly during the times of the year when fodder is poor and scanty, and in animals in poor condition. It may also be seen in young calves. It is seen not so much in herds kept on open grazing lands, as in the cattle of poorer people kept in or around villages and towns, where they pick up a great variety of inferior food and garbage.

Simple, or primary, chronic indigestion may sometimes commence in an acute form, as after gross over-eating, in draught cattle after fatigue or prolonged journeys, especially when they have been kept short of water, in cows after difficult calving, or in animals that have suffered from an exhausting disease. The atony of the stomachs is said to result reflexly often in these cases from failure of secretion (dyspepsia) of the digestive juices in the fourth stomach (abomasum) or the intestines.

* The first stomach (rumen or paunch) in cattle is a capacious organ (20 to 60 gallons in capacity); the food passes from it to the second stomach, a small organ of about one gallon capacity, with a honey-combed lining, and thus called the reticulum =network); it next passes to another small oval stomach (the omasum or psalter), the inside of which is traversed with a large number of closely packed leaves, which act as a filter for the food from the first stomach ; it then passes to the fourth, or true digestive stomach (abomasum), which is the organ that corresponds with the stomach of animals, and man, that have a single stomach. No true digestion takes place in the first three stomachs, in the sense that it takes place in the fourth stomach, the lining of which pours out juices that digest, or dissolve certain of the solid constituents of, the food. The first stomach, on the other hand, acts as a great storage vat, where in the presence of warmth and moisture the germs and ferments taken in with the plant food break up the coating (the celluloses) of the plant cells and liberate the nutritous contents (starches, oils, proteins). This fermentation and disintegration of the vegetable material is aided by the churning and contracting movements of the strong muscular wall of the first stomach, which also sends up the small compressed masses of solid material through the gullet to be rechewed at the animal's will, in the act of rumination. It has been explained that when there is excessive fermentation, with massive production of gases, the animal suffers from tympany of the rumen. When the food is such that it fails to ferment—either from the animal having greatly overeaten and distended the stomach (acute indigestion), or from eating innutritious food that will not be readily fermented and disintegrated and so accumulates in a heavy solid mass, (chronic indigestion), there occurs what is known as impaction. When anything interferes with the churning and contracting movements of the rumen, there occurs what is known as atony (or debility) of this organ.

The common chronic form, however, usually takes some time, often several days, before it becomes distinctly noticeable. It is caused chiefly by eating hard, dry, innutritious food, such as coarse hay, woody straw, dry shrubs and leaves, and also by certain low grade concentrated food, such as oil cakes with a large proportion of husks and other offal. Dry *jowari* stalks fed to animals that are not given access to a sufficient supply of drinking water frequently set up the condition. When such food has been taken and water drunk afterwards, it swells up considerably in the stomach, and, moreover, its nature is such that it ferments badly, so that it does not become macerated or disintegrated properly in the first stomach. Dirty or muddy drinking water, rotting and spoilt food and certain slightly poisonous fodders also bring about atony. A large quantity of earth or sand may settle in the rumen after taking dirty food or water for some time.

In some territories, cattle become affected with a peculiar form of indigestion manifested chiefly by a depraved appetite, with a craving for bones, rags, or other odd objects; this depravity is known as *pica*. It seems to be caused very often by a lack of certain salts, notably phosphates, in the fodder and in the soil. Where there is a deficiency of this sort, the cattle also become sometimes affected with a certain bone disease, known as osteomalacia; this is not common in India, but it is common in Ceylon. Cattle in some parts of India are well known to wander many miles, however, to lick natural salt deposits after feeding upon the herbage of localities that is presumably deficient in the requisite salts for proper nutrition.

Defective rumination and moistening of the food through broken teeth, injuries to the tongue, and insufficient repose in the case of work oxen are other causes. In calves, indigestion may arise through drinking bad milk or milk substitutes.

Secondary indigestion arises through inflammation of the stomachs caused by the action of foreign bodies or parasitic infection, or from pressure of the womb in advanced pregnancy or of adjacent tumours or swellings, or from diseases of the liver, peritonitis and many chronic lung or heart diseases.

SYMPTOMS. In the more acute, rapidly occurring cases, the symptoms are decreased appetite and thirst, with slackened rumination. These symptoms may pass off in a short time, either spontaneously or with suitable treatment, or they may assume subsequently the same general trend as in chronic cases. In these chronic cases, the symptoms commence slowly; the appetite is gradually diminished; thirst is often lessened and sometimes increased. Some animals show signs of depraved taste (pica) and become addicted to licking or chewing strange objects. Gases are eructated from the stomach more infrequently and have an offensive odour. Rarely, the animal vomits a thin offensive fluid.

Sometimes, the animal has a dry, husky cough. The left flank is usually distinctly swollen and hard at its lower part; the upper part is also filled out, when the impaction is accompanied by tympany. On the other hand, with continued loss of appetite the belly is tucked up, or diminished in size. Usually, signs of chronic, intermittent tympany remain for some time, and each time the appetite improves a little it recurs. On tapping or pressing the belly, the animal grunts and shows other signs of pain. The bowels, at first, are constipated; the dung is passed less often, and is hard, dark, and shining; rarely, the dung remains normal in appearance. After some time, the dung becomes soft and later liquid and offensive in odour. The diarrhœa then becomes continuous and is alternated with periods of constipation, and sometimes the animal shows signs of colic, or acute bowel pain. There is usually no fever, and the rate of breathing is only slightly increased. Meanwhile, the animal loses condition, and becomes dull looking, with a hard, unthrifty coat, and often marked stiffness of the limbs sets in. The milk yield falls off in cows.

In secondary indigestion, the symptoms of the primary affection may also be recognised.

Care should be taken not to confuse the symptoms of simple indigestion with those of cattle plague and other infectious diseases.

TREATMENT. The more acute, rapidly occurring cases nearly always recover in a few days with suitable feeding and treatment, while cases of chronic indigestion that are insidious in their onset are somewhat difficult to treat, and the affected animals suffer from marked loss of condition before they recover. In any case, food should be withheld for a day or two; then, for several days, until it shows distinct signs of improvement, the animal should be nursed carefully on an easily digestible, restricted diet. A little good grazing is the best diet, if it is available; otherwise, soft mashes or gruels, mixed with a small quantity of salt, should be given three or four times daily. Then, small quantities of good hay or cut grass and a little crushed corn (maize, gram, barley) should be offered in small quantities, taking care not to leave uneaten food in front of the animal to get stale. In the case of calves, small quantities of boiled milk, linseed tea, or hay tea and rice or maize gruel should be tried. Clean water should be offered frequently. If the indigestion is curable, it will nearly always respond to patient dieting. Medicines are of secondary value. Medicinal treatment should commence with a purge, when there is constipation, and the bowels should be kept in a fairly loose condition, by giving about four ounces of common salt or Epsom salts in the food daily. The addition of about an ounce of finely powdered bone meal to the food daily is recommended where *pica* is a prominent symptom. Also, a course of tonics, or so-called alteratives, may be given with advantage, administered daily

in the food, in exactly the same manner as has been described in the preceding chapter (Chronic Tympany). The flanks should be well massaged daily, and where possible, the whole body well groomed. In very obstinate cases, professional aid should be summoned, when it may be decided that the rumen should be artificially emptied (" incomplete rumenotomy "). (See page 99).

CHAPTER XXIV.

ACUTE INDIGESTION.

NAMES.—Impaction of the rumen: Over-eating or gorging.—Hind.—*Kabzi ; Bojh.*

What has been said about chronic indigestion applies very largely to acute indigestion, but here the symptoms occur much more rapidly and there is very distinct impaction of the rumen visible on examining the left flank. The first stomach becomes filled and dilated with hard, dry food to such an extent that its muscular walls fail to contract and deal with the food. Acute indigestion, or impaction of the rumen, occurs chiefly when an animal has been given liberty to eat as much as it likes of some appetising, dry food, to which it has not been accustomed, as, for example, when it breaks loose in a shed or yard and eats voraciously from stocks of good hay, corn or meal, or gets into a field of ripe hay or corn. Sometimes, also, the condition is set up when animals are put on quantities of hard, dry, or innutritious food, such as straw or lucerne hay. Certain kitchen refuse—potato parings, vegetable stalks—in large quantities may bring it about. Other causes are rapid change from green food to dry food, drinking large quantities of cold water after dry food, weak condition, often through prolonged keeping in stables, and inability to ruminate through long working hours.

SYMPTOMS. The animal looks uneasy, stands with arched back and legs placed well under body, has a dazed appearance, looks from time to time towards its flanks, sometimes kicks its belly, sweats, grunts, moans, lies down and then gets up. Usually, the appetite is lost completely at once, but in slighter cases it is merely diminished. Thirst is often increased. Sometimes, large quantities of gas are belched up, and in a few cases there is copious vomiting.

The left flank is noticed to be distinctly swollen at first, but later the whole belly may seem to be inflated. On pressing the belly over the paunch, it feels tight and very hard, especially at its lower part. At its upper part, it later sounds hollow, indicating the development of tympany above. The intense swelling of the paunch brings about difficult breathing, and eventually, in severe cases, suffocation.

The symptoms increase gradually in intensity until they reach their height in from a few to about twelve hours; they do not develop so rapidly usually as in acute tympany. Death may occur from suffocation within 24 hours. The mjaority of cases, however, recover spontaneously, usually in one or two days, though exceptionally they may last up to ten days.

TREATMENT. The animal's usual food should be withheld for one or two days always. The flanks should be vigorously massaged, the animal walked briskly, and the massaging then repeated. This treatment is sufficient in all cases that are not exceptionally severe.

In very severe cases, or persistent cases, that do not yield to the above simple treatment, some other means must be tried. Wherever possible, professional aid should be called in at once. If the animal looks as if it is about to succumb shortly, the owner should summon courage to administer first-aid treatment of the same kind as was recommended for acute tympany, by puncturing the upper part of the left flank, as there described, to relieve the paunch of accumulated gases. The tube should be left in the flank for two or three days or longer, for if it is withdrawn the gases are likely to accumulate soon again. A strong purge (1 or 2) is usually recommended, to be repeated in 24 hours; it is unlikely, however, that purges given by mouth will reach the bowels to exercise any purgative action in acute impaction. On the other hand, some of the purgative drugs now injected by professional men under the skin, such as eserin, pilocarpin, or arecolin, have this action.

The most rational treatment, and one upon which, it seems, increasing reliance is placed, in these worst cases of impaction is rumenotomy. The animal is secured standing against a wall. At the place indicated for puncture of the left flank by the trocar in tympany, a longitudinal slit about four to five inches long is cut through the skin and the various underlying layers of tissue including the wall of the rumen. The cut edges of the wall are then sewn back by means of a piece of strong cord as soon as the contents have ceased to surge out, on to the edges of the flank wound, leaving a window through which the rest of the rumen contents can then be removed deliberately, without running any risk of soiling the peritoneal cavity. The window may be left open, and if its edges are kept clean by washing with salt and water or some weak disinfectant fluid, it will heal up in a few weeks, leaving a shallow, puckered scar.

In the operation of so-called complete rumenotomy, the procedure is the same, but after the contents have been extracted, the edges of the stomach wall are cut loose and sewn together separately; the flank wound is afterwards sewn up.

These operations, in reality, are simple ones to a professional man with a little surgical skill, and they are briefly mentioned only to indicate to the stockowner what can be done in saving the life of his animal by calling in early professional assistance.

CHAPTER XXV.

TRAUMATIC INDIGESTION.

NAMES.—Foreign bodies in rumen, reticulum, or omasum; Traumatic reticulitis; Perforation of reticulum; Traumatic gastro-peritonitis, pericarditis, etc. Hind.—*Badhazmi jo kési nuokdar nakhurdani shé ki mĕhdė mén dakhal honé sé pada ho.*

Cattle are very susceptible to gross injuries (traumatisms) of the stomachs, caused by swallowing sharp objects capable of traversing the stomach walls, or blunt objects capable of blocking up the openings to the stomachs or of overloading the first stomach so that it cannot perform its regular movements. As a rule, it is adult cattle, and more especially cows about four years old, that suffer from stomach injuries caused by sharp objects. These animals often show a craving for chewing sundry articles, which they may pick up in abundance in the neighbourhood of houses or workshops, and so this class of injury is especially frequent in cattle that stray and pilfer in towns and villages; such cattle often develop an artful habit of bolting intact any odd objects that take their fancy. In this way, they may pick up needles, nails, small tins, pieces of wire, bits of wood, often attached to some delicacy, and even large objects such as knife handles. The larger objects are more likely to produce choking, if their size and shape are such that they will not readily pass down the gullet. Sometimes, however, cattle that are well fed, in open fields, become affected in this way, when, for example, they pick up while grazing odd small bits of rusty wire from some old fencing.

Calves, more especially, may have in their stomachs very compact round masses, which may reach the size of a fist, called "hair-balls." These balls arise from the habit of licking the hairy coats either of themselves or other cattle, and the hair in the stomach becomes rolled in time into a ball by adhesion with certain glutinous and earthy materials.

Sand and gravel have already been mentioned as foreign substances capable of causing indigestion; sandy material amounting to over 60 seers in weight has been found in the rumen of a beast. It is taken in with the food on sandy, or dusty land, or with muddy water, such as may gather on flooded land.

SYMPTOMS. Blunt objects set up chronic indigestion. A large amount of sand, or some hair-balls, may set up the symptoms of this disorder which has been already described. Very often, single blunt masses cause little or no disturbance, but sometimes they may block

the openings of the stomach and cause sudden symptoms (*see* Choking and Acute Tympany).

Sharp objects sooner or later become impinged in the stomach walls, and it is, as a rule, the honey-comb spaces in the wall of the second stomach (reticulum) that are punctured. Small sharp objects are much more dangerous in this respect than larger ones. The fate of the object depends upon its shape, the part of the wall perforated, and the direction it has taken. If it is an object such as a needle, a small piece of wire, a sharp splinter of hard wood, pointed at both ends, it will traverse the stomach wall, through the action of the stomach movements ; in a large proportion of cases, it then finds its way forward through the diaphragm, into the cavity around the heart, to set up acute inflammation (traumatic pericarditis), or into the chest cavity and lungs (acute pleurisy). Sometimes, it works in another direction, into the spleen or lever, to set up acute disease in these organs, or it may penetrate the belly wall, to appear under the skin in front of the navel, or even work its way under the skin towards the elbow, where abscesses develop. In any of these migrations, it has to traverse the belly cavity (the peritoneal cavity), and sets up peritonitis of varying degrees of severity. The symptoms that arise with the perforation of any vital organ will be somewhat sudden in their appearance and acute. The object exerts its baneful effects mostly by carrying the germs of abscess formation along with it from the stomach cavity.

If the object is blunt at one end, as with a sharp nail, and it fails to emerge completely from the stomach wall, the injury will remain confined largely to the vicinity of the puncture. A local abscess, with much thickening of the stomach wall will be set up, with some degree of atony of the stomach, resulting in symptoms of an obscure chronic indigestion, and there will be a more or less diffuse, sub-acute or mild peritonitis, with exudation, in most cases, of fluid into the peritoneal cavity.

The symptoms seen after perforation of the stomach wall with a sharp object may thus develop quickly or very slowly. When they progress fast, they are very similar to those seen in simple indigestion of a sub-acute type : appetite is suddenly diminished and becomes irregular ; rumination is suspended or weak ; swallowing frequently seems to produce a choking sensation ; often, chronic tympany, and also distinct impaction of the rumen ; belly generally distinctly tucked up ; rumblings cease or are few inside the belly ; dung passed in smaller quantities, and sometimes streaked with blood. Added to these symptoms of simple indigestion, the animal shows signs of very pronounced abdominal pain ; anxious expression ; reluctance to walk or move ; arched back and feet kept together under belly ; grunts and moans with every movement, such as on lying down or getting up, on turning, and especially walking up or down a slope ; sometimes, colicky pains, shown by

the animal kicking its belly, stamping, switching its tail; often, distinct trembling of the muscles of the fore quarters, especially after the animal has been standing for some time; marked sensitiveness on pressing underneath the belly just behind the breast bone. With the progress of these symptoms, the animal becomes dull, has slight fever, rough coat, hot or cold ears and horns, quickened shallow breathing and rapid pulse, and sometimes dropsical swelling under breast. Sometimes, abscesses then develop under the skin of the belly or, further away, on the breast, or near the elbow. In cows, these symptoms lead to a cessation of the milk yield. In many cases, these acute symptoms gradually disappear to some extent after a time, sometimes to reappear after a considerable interval. When the heart or other important organ becomes directly affected, the symptoms assume a very acute course, with high fever, and the animal soon succumbs.

In slowly progressing cases, caused by less sharp objects that do not traverse the reticulum completely or traverse it very slowly, symptoms of pain are scarcely seen; the course of the disease is like that of a mild simple indigestion, from which the animal often seems to recover in a few days, to recur in a few weeks or a few months, especially after the animal has undergone fatigue as through over-work or calving; the nature of the disease may be suspected from the fact that the ordinary treatment for simple indigestion has little or no effect upon its course; abscesses that discharge a stinking fluid then develop sometimes under the belly. In these cases, the professional man may be able to diagnose the disease with certainty by tapping with a hollow needle the lower part of the belly, when an exudate is withdrawn indicating the presence of peritonitis.

Treatment. Very unsatisfactory. The condition has been described at some length to prepare the cattle owner for failure in the treatment of cases which he might otherwise suspect to be those of simple indigestion. Purges are not helpful and may actually cause harm. On the other hand, large doses of oil (linseed or castor oil) given in pint or quart doses, treacle (one seer), or linseed tea ease the bowel considerably. Solid food should be withheld until the symptoms abate, plenty of water (luke-warm, if the weather is cold) given to drink and the animal sustained on rice or flour gruels and mashes. Some professional men now resort to rumenotomy, with careful exploration of the interior of the reticulum and rumen, to discover the foreign bodies and remove them.

Prevention. The origin of the foreign bodies has been indicated at some length, and the owner ought to take steps as far as possible to see that his cattle are not allowed access to them. In localities where the cattle are prone to show symptoms of *pica*, which are usually especially evident at certain times of the year, owners can well prevent the addiction to chewing and swallowing harmful objects by giving each

animal daily with its food a mixture composed of one to two ounces of common salt and one-half to one ounce of finely powdered bone meal, the quantity given depending upon the size of the animal and the degree of its addiction.

CHAPTER XXVI.

OTHER BOWEL DISORDERS; DIARRHŒA; DYSENTERY; CONSTIPATION.

NAMES.—Hind.—*Digar Bimari-e-imaha* (=Other bowel disorders); *Dust*: *Ishal* (=Diarrhœa); *Pechis*: *Maror* (=Dysentery); *Qabz* (=Constipation).

For a proper comprehension of the bowel disorders of the ox, the raeder is invited to study briefly the arrangement and function of the bowels * and what has been said in the Introduction upon the healthy maintenance of animals.

* It has been stated in the preceding chapters that the stomach of the ox consists of four large compartments:—(i) The rumen or paunch; (ii) the reticulum; (iii) the omasum or psalter; (iv) the abomasum, or true digestive stomach. The stomach fills up three-quarters of the belly cavity and occupies nearly the whole of the left flank. Its capacity amounts, in an average-sized animal, to 30 to 40 gallons (in a large animal, 40 to 60; in a small animal, 25 to 35). The rumen comprises 80 per cent., the reticulum 5 per cent., the omasum 7 or 8 per cent., and the abomasum 7 or 8 per cent. of the total volume. The abomasum opens into the small intestine, which is, on an average, 130 feet in length and two inches in diameter, and is attached as a kind of festoon or fringe to the borders of the thin sheet called the mesentery. The first part of the small intestine is called the duodenum, about three or four feet in length; into it open two tubes, or ducts—one from the liver, known as the bile duct, and the other from the pancreas, known as the pancreatic duct. The small intestine is continued into the large intestine, at the commencement of which there is a blind dumb-bell shaped sac, called the caecum, about 30 inches long and 5 inches in diameter; this opens into the colon, which at its commencement is about as wide as the cæcum but later narrows down to a diameter of about two inches; the colon is on an average 35 feet in length. The last part of the large intestine, situated within the pelvis, is known as the rectum; it is about a foot long, and opens outwardly at the anus, which opens and closes by the action of a strong muscular ring.

When food is taken in by the mouth, it is first chewed and thoroughly mixed with the watery fluid known as the saliva poured out in great abundance by the salivary glands. It is then swallowed and in the rumen it undergoes massive fermentation and disintegration resulting from the action of the bacterial ferments taken in with the food. When the animal is at rest, small masses of the contents are squeezed out and passed up the gullet again to be re-chewed thoroughly; this act of chewing the cud, or rumination, is a very important one in the digestion of the so-called ruminants, and disturbance or cessation of it is one of the most certain signs of ill-health. The arrangement of closely applied leaves within the omasum acts as a filter towards the contents of the rumen and also serves to grind down coarse particles of food, before the material passes on to the abomasum, or true digestive stomach, which corresponds with the single stomach of animals that only possess one stomach. The walls of the abomasum contain minute glands which pour out a digestive juice containing a ferment (pepsin), that dissolves and breaks down the albuminous fractions (proteins) of the food, and in the calf the juice contains another ferment (rennet) that clots the milk.

When the food next gets into the intestine it is acted upon by three juices:—(i) the pancreatic juice, arriving by the pancreatic duct from the pancreas; (ii) the bile, made by the liver, stored in the gall-bladder and poured into the duodenum through the bile duct; (iii) the intestinal juice, poured out by the innumerable small glands in the walls of the intestine. In the pancreatic juice, there are ferments which act further upon the albuminous substances, break down the starches into simple sugar, and break the fats, after emulsification by bile, into soluble soaps. The intestinal juice also contains a ferment that acts very actively upon albuminous substances.

The causes which lead to Indigestion, as described in the preceding chapters, also tend in large measure to produce disturbances further along the bowel. Whereas, however, the lining of the fore-stomachs is skin-like and relatively inert, that of the abomasum or true digestive stomach and of the intestine is very sensitive, as it is composed of a delicate secretory and absorbing surface made up of irritable cells. Disturbance, irritation, or injury to the bowel surface may therefore cause :— (*a*) catarrh, which in veterinary writings refers to a mild superficial inflammation, with much derangement of the secretory and absorbing functions of the bowel and of its movements ; (*b*) a deep-seated inflammation, or gastro-enteritis, with much damage to t e issues a marl.ed reaction, bleeding (hæmorrhage), deposition of a so-called croupous or diphtheritic exudate on the surface, and sometimes extensive loss of surface tissue (ulceration). The two conditions often merge into each other, for gastro-enteritis is not uncommonly preceded by a condition of acute catarrh.

The most prominent symptom of bowel derangement is diarrhœa, but it is by no means a constant symptom, especially in cattl. ; hence, in the present edition of this book, the bowel disorders of cattle are not treated collectively under the heading diarrhœa. A very large proportion of the unthriftiness seen in cattle in India, without striking diarrhœa, is attributable to some kind of bowel disorder, which can be remedied by the stock-owner on understanding its nature and removing the cause.

Bowel catarrh may be acute, when it appears rather quickly and the symptoms are very prominent. or it may be chronic when it comes

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This breaking down of the various food components into chemically simple, soluble substances is digestion, and its object is to provide material that can be readily absorbed, or assimilated, by the surface of the intestine. The food material is passed onwards by the worm-like movements (peristalsis) of the stomach and intestines. After absorption through the bowel wall, the digested food is taken by the blood or lymph stream, and for the most part is transformed by the liver—which is the great chemical clearing-house of the body—into the precise chemical materials required by the animal. Excess over immediate requirements is largely stored as fat, to be drawn upon at a future time in case of need. Otherwise, the materials are used by the tissues for repair, growth, and as sources of energy, and the waste products are excreted by the lungs in the form of carbon dioxide gas or by the kidneys, as urea, dissolved in the urine, in the case of albuminous waste products.

What cannot be dissolved by the digestive juices in the stomach and intestines, and absorbed into the system, is passed along the bowels, stored for a time in the large intestine, where a portion of its water content is absorbed from it, and finally evacuated through the rectum, as fæces or dung. The amount of dung evacuated daily by a beast comes to 15 to 40 seers ; when the animal is fed on large quantities of rich food it may be one and a half times the average amounts. The dung still contains a certain, definite proportion of the food elements that have not been digested, and when dung is spread on land for agricultural purposes, it is the undigested albuminous fraction, mainly, on decomposition within the soil, that contributes to its very high fertilising qualities. The stock-owner will find it difficult to grasp the full meaning of good feeding and bad feeding, digestible and indigestible foods, and bowel disturbances, without a little understanding of the processes to which food is subjected after it has been eaten. The arrangement of the bowels is depicted on the Plate at the end of this book.

on gradually and may last several months. When it affects the fourth stomach or the commencement of the small intestine only, symptoms of diarrhœa are absent, and the animal shows signs of unthriftiness, varying in degree; there may be even prolonged retention of the dung (constipation). When the hinder portion of the bowel is affected, diarrhœa is a constant symptom.

In gastro-enteritis, the symptoms are usually much more intense; marked diarrhœa, often with an abundance of blood in the dung (dysentery), and much slime and often shreds of the lining membrane; the general bodily disturbance is also much more pronounced and, as a rule, the chances of recovery much smaller.

Simple constipation is rare in cattle, as the material passed on from the rumen to the bowel is nearly always very watery; when an animal is fed on food that might be assumed to have a constipating effect, the signs of derangement become noticeable primarily as those of chronic indigestion, which has already been described as an affection of the fore-stomachs in cattle.

CAUSES. (*a*) *Simple bowel disorders.* Bad feeding is the most common cause.

Among the causes of acute gastric, or fourth stomach, catarrh may be mentioned :—Eating unsuitable food, such as coarse grass, certain shrubs and tree leaves, in jungle grazing; locally bred cattle may have become habituated to this food material, while cattle newly imported into the vicinity may prove very susceptible. Sudden change of fodder, as after the commencement of rains, or on turning out to rich pasture; spoilt food, such as badly gathered hay, mouldy hay or straw. Injuries to the mouth, causing excessive salivation, or inability to chew food properly. Irregularity of feeding; feeding too quickly, in hungry or greedy animals. Dirty or foul water; drinking too much water after intense thirst. Inability to chew the cud properly, often through prolonged work. Chronic gastric catarrh is set up by the same causes, long continued; frequent causes are sand or earth in water and food; repeated overwork.

The causes of acute intestinal catarrh are of the same order, but often more intense :—Certain green plants, such as clover, when first fed to the animals; other fodder, which has somewhat acid qualities; products of sugar manufacture. Foul and sour fodder, infected with moulds and other germs, capable of breaking down the resistance of the intestinal lining. Sudden chills; also, in hot weather, there has been noticed a diarrhœa in cattle suspected to be caused by unclean water. In working cattle, there is known to occur in the hot weather a catarrh lasting a short time, when they have drunk a large quantity of water after they have become very hot.

In certain parts of India (STIRLING, Central Provinces), there occurs very commonly a seasonal diarrhœa of cattle, that makes its appearance shortly after the break of the rains (June, July), and is accompanied by rapid loss of condition and decreased endurance in working bullocks and markedly diminished milk yield in milch animals. The condition persists for nearly a week on an average, with ordinary treatment, and it is suspected to be caused by eating certain plants, notably a leguminous weed known as green *tarota* (*Cassia tora*), that grows in abundance with the onset of the rains and is not eaten ordinarily in the drier condition, when other fodder is available.

The bowels of young animals are peculiarly sensitive. Withholding the colostrum, or first milk, makes the bowel lining highly susceptible to attack. Other causes are bad milk, overfeeding, diseases of the mother's udder or womb, mother's diet, particularly when it contains certain acid or other slightly poisonous properties, excreted with the milk; change of food at the time of weaning.

Simple chronic intestinal catarrh is rather uncommon in cattle; when chronic diarrhœa is seen, specific diseases, such as worm infections or Johne's disease should be suspected; it accompanies chronic diseases of other parts of the body (heart, liver, lungs) also quite often, and is frequently a sequel to acute intestinal catarrh. However, the simple conditions may arise from the same causes as the acute disease, and notably from unsuitable or spoilt food.

There is, in cattle, a fairly common bowel affection which is known as pseudo-membranous (or muco-membranous) enteritis, from the appearance of large casts in the dung, and which is seen especially in young well-nourished cattle after a period of dry feeding when they are put on pasture land.

Simple gastro-enteritis sometimes develops from the catarrhal disease, but it often arises suddenly, and chiefly from disturbances in feeding of the same order. Among the causes are:—Decomposed and very mouldy food. Oil-cakes, or other food, containing castor oil beans, a small quantity of which can set up a very fatal dysentery. Many plants not specially cultivated and evolved as fodder plants, such as bamboo leaves, on certain classes of cattle. Water that has flowed away from manure heaps sometimes causes a very serious disease of this kind. Sometimes also, the disease appears after feeding with food that appears quite blameless, and recent knowledge has shown that in certain localities, such as in particular cattle-sheds, bacterial germs that would not ordinarily be looked upon as harmful may increase in virulence so as to acquire properties similar to those of the dysentery bacteria of man. These germs may be found in the floors or bedding, but they are also believed to be harboured by the healthy well-fed cattle of the place,

and to display their pernicious effects on cattle the resistance of which has been lowered by wretched feeding. We have known in India a large number of buffaloes succumb to intense bowel disease, with peritonitis caused by a type of germ that is almost ubiquitously the cause of ordinary wound infection (*Bacillus pyogenes*) after they had been housed in a set of sheds now known to have for sometime a somewhat evil reputation in this respect. In calves, veritable outbreaks of this type of disease may occur (caused by the necrosis bacillus, and other organisms; " white scour " is dealt with in a separate chapter). Other causes are fatiguing journeys; very irritant sand or mica particles in the drinking water.

Constipation, when it occurs, as it does rarely by itself, in cattle, is caused by very dry, indigestible food; certain plants, containing astringent principles; mouldy grass or hay; long journeys; dirt (sand) in water or food.

(*b*) *Secondary bowel disorders.* In many of the specific infectious diseases described in this book, bowel disorders have been classed as important, often the most important, accompanying disturbances. Examples are cattle plague, hæmorrhagic septicæmia and anthrax, as infectious diseases in which together with the high fever and other general symptoms, there are marked symptoms of diarrhœa and often dysentery. Coccidiosis has been described as an infection which sometimes gives rise to pronounced symptoms of diarrhœa and dysentery. Johne's disease is a striking example of a specific infectious disease which attacks the intestinal wall and is manifested by a very chronic form of diarrhœa. Tuberculosis affecting the bowel is also exhibited by similar symptoms. The worm diseases are mainly bowel affections, and the symptoms observed in the course of these diseases have already been described. Further, in the course of several exhausting diseases, notably those affecting particularly the heart, liver, or lungs, there occurs a congestion of the stomach and intestines, with catarrhal symptoms. The more severe forms of bowel trouble, gastro-enteritis, are also caused regularly by the action of certain poisons, of the so-called irritant or corrosive class, comprising strong acids or alkalis, phosphorus, arsenic, lead, mercury, carbolic acid (phenyle), croton oil, cantharides, lupins, and a number of plants containing irritant principles, (*see* chapter on Poisoning).

SYMPTOMS. The symptoms observed in the various kinds of simple bowel disorders may be graded as follows:—(*a*) loss of appetite and general unthriftiness without distinct diarrhœa or fever; (*b*) loss of appetite, general unthriftiness, and marked diarrhœa, but no distinct fever; (*c*) marked diarrhœa, often with dysentery (blood in the dung), and casts and severe general symptoms (fever, loss of appetite, depression).

(*a*) The animal is always more or less off its feed, and chews its cud languidly or not at all : often has a depraved appetite (pica) and is addicted to licking and grinds its teeth ; dull ; arched back ; breath has an unpleasant odour ; milk decreased in quantity ; flanks often sunken; evacuates dung infrequently ; ears hanging listlessly ; thirst may be increased or decreased. This condition may be somewhat acute for a time, but if the animal is put on a proper diet, it disappears in a few days. It may, however, assume a chronic course lasting several weeks or months, when the cause persists, and the animal then often shows slight attacks of diarrhœa alternated with constipation, weakness and wasting, and then dies. This train of symptoms generally indicates a catarrhal affection of the abomasum and also of the commencement of the intestine.

(*b*) The symptoms commence nearly always as described in the preceding paragraph ; loss of appetite, dullness and retention of the dung. After a day or two, the dung becomes sloppy and then quite liquid ; often contains masses of undigested food, and is mixed with slime ; odour very offensive ; hind quarters and tail soiled ; dung evacuated frequently and in large quantities, sometimes with much straining ; belly often tucked up. The animal may show signs of colic (pain in the belly) ; moans or grunts ; kicks belly with hind legs. Thirst is usually very pronounced ; the surface of the body is of uneven warmth—ears and legs unusually hot or unusually cold. In more advanced cases there is rapid exhaustion (debility) ; the animal lies down without moving ; eyes are sunken ; hair stands on end, breath is offensive ; and the whole body emits a stinking odour ; death soon follows in these cases.

Symptoms of this kind indicate an acute catarrh of the intestine. The lighter cases may last only a couple of days, but usually they last a week or longer, after the cause has been removed. When animals are affected with the advanced type, with obstinate persistent diarrhœa, they become exhausted and die after about three weeks. In very severe forms, they may die in three or four days.

In the severe kind brought about sometimes by the eating of sugar by-products in other countries—and a similar kind has also come to our notice in India—there is also very marked bloody discoloration of the urine ; much sweating ; a stilted walk, and heart weakness ; death occurs often afterwards.

As a rule, acute diarrhœa of the kind here described is only dangerous in very young, weak, or very old animals.

Diarrhœa of this kind may assume, but not very frequently in cattle, a chronic form, lasting sometimes several months, when the cause of the disorder persists. In these cases, however, suspicion should be directed towards the specific infectious diseases, notably worm infections and Johne's disease.

In the so-called pseudo-membranous enteritis of young cattle turned on to grass-land for the first time, there are seen large shreds (casts) of bowel lining in the fluid dung, trembling of muscles and signs of colic. Usually, the condition lasts only a little over a week, when the animals spontaneously recover.

(c) As a rule, the animal gets acutely ill at once; stops feeding and chewing the cud; shows signs of pain in the belly; sometimes vomits or retches; often, pronounced tympany at the beginning, but later the belly gets tucked up. There may be constipation for the first day, but then intense diarrhœa commences, with painful straining, blood and shreds of tissue in the dung, which later is evacuated involuntarily. The animal shows fever, varying in degree; much accelerated, weak pulse; cold extremities; skin covered with sweat; eyes sunken; staggers and sways, and often shows cramp of the muscles; swellings sometimes appear under the skin. Severe cases of this kind may end fatally in the first two days; otherwise they last one or two weeks; recovery is rare. If the animal recovers, convalescence is long.

The symptoms of simple constipation in cattle are obstinate retention of the dung; tympany very frequently; no marked signs of uneasiness. The dung is hard, dry, evacuated in small quantities and it is often covered with masses of slime. The animal grinds its teeth a good deal.

Treatment. The treatment of an animal suffering from a simple bowel disorder will depend to some extent upon the severity of the disease, but a few general directions may be laid down for observance by the stock-owner:—

- (i) Make sure that the disease is not one of the specific infectious diseases, which require special treatment, and the spread of which can be much curtailed by early action.
- (ii) Rest the animal completely and withhold all food for one or two days. Give it in the meantime plenty of clean water to drink.
- (iii) If there is diarrhœa, do not attempt to stop the diarrhœa to begin with,—unless it be of the most severe type, with dysentery, when, in fact, treatment is not very likely to succeed. The diarrhœa is Nature's method of getting rid of irritating substances from the bowels.
- (iv) If the disorder has not upset the animal very much, no medicine will be required; instead, after withholding food, put the animal on to soft, easily digestible food, in small quantities, given often, for a few days, until it recovers. Good, fresh grass is about the best food of this kind; otherwise, give mashes, gruels, mixed with a handful of salt, daily. See that this is done, so far as you can, under your own supervision.

(v) Make every endeavour to ascertain the cause of the disorder —bad food, overwork, dirty water, etc., and take steps to avoid a repetition of what you suspect to have been the cause.

(vi) When the animal is much upset, with marked unthriftiness and loss of appetite and much diarrhœa, and always in cases of constipation, it is a good plan to assist Nature by giving the animal a mild purge or laxative to hasten away the irritation inside the bowels. If it is decided to give medicines, therefore, commence with one of the following :—(*a*) Epsom or Glauber's salts, ½ to 1 lb.; (*b*) see 1—in Appendix, not 2, which should only be given in bad cases of constipation ; (*c*) a good purge is castor oil, from ½ pint to 2 pints, according to the size of the animal, for adults ; from one ounce to four ounces for calves ; or somewhat more than this quantity of linseed oil ; a good drench can be made by shaking the oil vigorously with twice its volume of warm water, to which a handful (in the case of the adult dose) of salt has been added ; (*d*) treacle, given either alone or with the other purges, in quantities of one to three pounds.*

(vii) If the animal shows signs of severe colic, which is not relieved by the purge, or which is causing the animal great distress, give a dose of anodyne, narcotic medicine (9).

(viii) If the diarrhœa persists for some days, without showing signs of abatement, and the animal is getting weak, give the animal a course of astringent medicine (7), until the diarrhœa commences to stop. For calves and also often for adults, a safe mild astringent consists of lime water, given with the drinking water or as a drench. The lime water can be readily made by shaking up a handful or two of quicklime in a bucketful of water, preferably rain water. The solid lime is then allowed to settle down to the bottom, and the clear liquid taken away when it is needed. For adult cattle from one to four pints, according to the size of the animal and the effect desired, can be given twice daily ; for calves, from one-half to one pint.

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* In the seasonal diarrhœa that has been described as occurring in certain parts of India after the break of the rains, treatment with permanganate of potash, on the lines sometimes adopted in human cholera, has been recommended (STIRLING). Twenty grains of the permanganate crystals are dissolved in two pints of water, and given to the animal as a drench. This quantity is what is advised for a mature bullock, and the dose can be raised according to the size and state of the animal. The drenching is repeated every half-hour until two drams of the crystals have been given. Usually, purging stops by the time six doses have been taken ; if it has not by this time, the treatment may be continued.

(ix) In the very severe cases of diarrhœa, with dysentery, fever and other general disturbances, place the animal in a quiet, clean, dry, well-ventilated place. Cover the body with straw or old blankets if the animal is shivering and the extremities are cold. Withhold food for the first day, and then drench three or four times daily with gruels, such as rice or barley gruel, or linseed tea mixed with gruel (about one part of linseed tea to two parts of gruel). If the animal is very depressed and exhausted, give stimulant medicine (3). If it shows signs of severe colic, give anodyne medicine (9) and repeat in four or six hours if the animal has not been relieved. In these cases, there is much damage to the bowel wall, and purgatives, especially those containing irritants (such as croton oil) should on no account be given. Mild laxatives, such as a few ounces of salts daily, may be beneficial. The most important part of the treatment is, however, good nursing, with soft food, clean water, given frequently, and careful attention during convalescence when the animal's condition has commenced to mend.

(x) Do not leave food in front of an animal that is not feeding properly, after it has finished eating what it wants, to become stale. Take it away, and offer a small quantity of fresh food after an hour or two.

CHAPTER XXVII.

WHITE SCOURS IN CALVES.

NAMES.—Red scours; Navel-ill; Joint-ill. Hind.—*Bachdo-mén safĕd-Ishāl; Bimari-é-naf; Joronki-bimari.*

In Western countries heavy losses are often sustained on establishments where cattle-raising is carried out as an intensive industry through serious disorders in new born or young calves known variously by the above descriptive terms and spreading locally in the manner of contagious diseases. In India, these diseases seem to be relatively rare, which may be construed as the outcome of the common method of maintenance of cattle, in the open, but, nevertheless, they have come to our notice in certain valuable herds where the methods of maintenance resemble those of the West. Much light has been thrown upon the nature of these diseases during very recent years by the labours of bacteriologists, and the kinds of infection that give rise to them may be classed roughly in the following manner:—

A. Germs of the same kind as those that are found abundantly in the intestinal contents of normal cattle, and are known collectively as the colon bacillus (*Bacillus coli*), and differ from these germs of normal cattle only in that they have acquired, through unhygienic conditions of the environment, the faculty of attacking the delicate bowels of new-born calves. Bacteriologists are able to divide the germs of this group into a number of different types, from the nature of the immunity developed by the body against them. It has now been proved that one of the chief reasons why these germs gain a foothold in the new-born calves is the withholding of the colostrum, or first milk, of the mother: the colostrum contains certain very important ingredients that fortify the bowel against germ invasion during the first few hours of life. When the colon germs have once gained a foothold in the tissues of the calves, they become endowed with greatly increased invasive powers towards other calves, and so after disease has been set up in this way, infection can be transmitted readily by the hands of attendants, soiled litter, and other like means, which are much accentuated, naturally, when the calves are born, and maintained during the first hours of life, in close, confined, and unhygienic surroundings. The disease not infrequently appears also on establishments where the colostrum is customarily given to the calves, and in these circumstances, it must be assumed that the germs have become infective through defects in maintenance of the calves.

B. Germs that are very rare in, or absent from, the bowels of normal cattle, and are known as the paracolon bacillus; near relatives of this

germ are the common germs of so-called food-poisoning in man (Gærtner's bacillus), and the paratyphoid B germ of man. In an infected establishment, this germ is "carried" in the bowels of the normal cattle, and also on soiled floors and litter. As a rule, the infection attacks older calves, from two to six weeks old, and serious inflammation of the joints frequently accompanies the disease symptoms.

C. Germs which correspond mainly with those of ordinary wound infection, and which set up disease manifested outwardly chiefly by marked inflammation of the joints. With this class of infection, the germs often gain entry through the raw navel of the new-born animal. [The most common types in calves are diphtheroids (*B. pyogenes*), pasteurella organisms (*B. bipolaris septicus*), colon bacilli (*B. coli communis*), and streptococci].

From what has been said about the causes of the disease of the new-born, the reader will readily appreciate that they present a very difficult problem for the expert in devising methods of control for animal disease. In some of the specific diseases already dealt with in this book, the problem of control has been represented as a relatively simple one: for example, in cattle plague or hæmorrhagic septicæmia we have formidable diseases that are each caused, however, by a single germ, and products—sera or vaccines—can be fairly readily made to deal appropriately with the diseases so caused. In the group of affections of the new-born, designated variously by their more prominent symptoms, as white scour, joint-ill, etc., we are confronted with a problem that is unusually complicated, for, from the point of view of specific control, the infection caused by each germ, and every so-called type of each germ, must be regarded as a separate disease, if we endeavour to combat it by protective inoculation.

Symptoms. In the common white scour, caused mainly by the colon germs, the disease begins often a few hours after birth, and, most frequently, on the first or second day; sometimes, on the third or fourth day, and rarely later. At first, the affected calves show weakness and difficulty in rising; loss of appetite; often, straining and other signs of pain in the belly; irregular distribution of body warmth; high fever (106° F. or more). Very acute cases may die before diarrhœa commences. Diarrhœa is, however, almost constant, and the droppings are fluid, yellowish, stinking, and often mixed with blood. Sometimes the affection becomes chronic, with continuous diarrhœa, wasting, and exhaustion, and the calf dies after several weeks, or recovers slowly, and remains stunted in its growth.

In the second class of infection, the disease appears not in the new-born but in calves at least five to eight days old, and most often in the third or fourth week. The symptoms vary greatly. The disease commences suddenly, with high fever (106° F. or more), marked weakness,

increased rate of breathing and decreased appetite. Constipation, at the beginning, is followed by diarrhœa. Inflammation of the lungs (pneumonia) and swelling of the joints occur frequently. The disease lasts eight to fourteen days, sometimes four weeks. The disease may attack 45 to 90 per cent. of the calves, and cause a death rate of 25 to 30 per cent.; sometimes, in severe outbreaks, it is 60 per cent.

In the third class, the disease usually appears one or two days after birth, with symptoms of fever and general depression; sometimes, the navel cord is noticed to be obviously diseased. Painful swellings then appear in one or more joints. Diarrhœa occurs in most cases, and lung complications are frequent. The symptoms may terminate fatally within a few days, or assume a chronic course, lasting sometimes several weeks. The death rate is about 50 per cent.

TREATMENT. General treatment should follow the same lines as have been indicated for other bowel disorders of cattle: good nursing; clean well-ventilated surroundings, with applications of warmth if the body surface is cold. If the calf refuses to suck, it should be drenched carefully from a bottle with a few ounces of milk three or four times daily. A mild laxative, such as one to four ounces of castor oil, may be given at first, followed later by mild astringent medicines, such as lime water, given in the manner described in the previous chapter, or animal charcoal (one ounce shaken up with a little milk, given as a drench twice daily). If the calf is much depressed, a mild stimulant (3, about one-tenth of the dose for an adult) should be given; or, a small dose of anodyne medicine (9, one-tenth adult dose) if there are pronounced signs of pain in the belly.

PREVENTION. Preventive measures can be devised upon the lines indicated by our knowledge of the nature of the condition. Wherever it can be arranged, cows should be allowed to calve in the open and rear their offspring for the first few days of life in a place that has not been soiled by other animals from the infected herd. So far as possible also, persons who have been in attendance upon other calves, especially infected calves, should be excluded from contact with the new-born calves. Much attention has been given in the past to disinfection of the navel of new-born calves. This procedure is undoubtedly advantageous in dealing with the joint-ill class of infection, which is the common type in foals. However, as the ordinary white scour of calves is transmitted chiefly by the mouth, the procedure is not likely to be of much benefit in this class of infection. Success is more likely to attend measures aimed at improving the general hygienic maintenance of the herd, with dispersion of congestion. Care should be taken that the calf gets an ample supply of colostrum from the mother.

Specific preventive measures are difficult of application, although in some countries they seem to have been attended with remarkable suc-

cess. They consist in isolating the germs responsible for the infection, preparing an antiserum against all the types mainly responsible, and inoculating the calves as soon as possible after birth with a protective dose (10 to 15 c.c.) of the serum. There is no reason why this process should not be applied to valuable herds in India in which the disease is a persistent menace. Professional aid should be sought to collect the necessary morbid material from affected calves and forward it to a bacteriological laboratory for the preparation of stocks of anti-serum.

CHAPTER XXVIII.

WOUNDS AND OTHER INJURIES.

NAMES.—Hind.—*Zakham ; Chot.*

Under this heading, it will be convenient to treat of the very common accidents of cattle caused by gross external injury; namely, wounds; contusions, bruises or abrasions; abscesses or boils; sprains or strains of muscles or tendons; fractures or broken bones.

Wounds, or breaches of the skin or flesh, are of various kinds, depending upon the shape and size of the object that has inflicted them and the part of the body in which they occur. Their gravity and the mode of treatment best suited for dealing with them will depend largely upon the kind of wound. Wounds in certain situations, such as those that penetrate the joints, or chest or belly cavities, are particularly grave. The manner in which wounds heal naturally has been briefly described in the Introduction. Almost all wounds in animals become inevitably infected, with germs introduced with the object that inflicted the wound, through dirt from the surrounding skin or from the air. In most cases, the natural defences of the wounded tissues are sufficient to overcome the retarding influence of infection upon healing, so that the wound heals, with the formation of a dense layer of new tissue, the scar tissue, to join up the divided surfaces. Sometimes, however, much local inflammation occurs through the extension of the infection, and, not uncommonly, the infection spreads throughout the body, producing the serious condition popularly known as blood-poisoning. Wounds in cattle may also become contaminated, with certain specific infections, with subsequent disastrous results: such as, tetanus, or lockjaw, which usually gains entry into the smaller wounds inflicted on the extremities, and the germ of which is commonly found as a normal inhabitant of manure, patches of land highly congested with animals, and cultivated soils generally; so-called malignant œdema or gas gangrene, in cattle usually quite indistinguishable from common blackquarter; rabies, from the bites of rabid dogs. In India, during the fly season, ordinary wounds stand in grave danger of massive infection with maggots.

Contusions, bruises, abrasions, or sores are terms applied usually to more superficial injuries. The injury produced, however, by a severe blow, such as that of a cart shaft, may lead to a so-called contusion in which deep structures—muscles, blood-vessels, ligaments, tendons—are badly damaged without breach of the overlying skin. Bruises are very common in working cattle, in the form of yoke galls and other harness injuries, shaft galls and injuries caused by lying down on and getting

up from rough hard surfaces or ground covered with decomposing, irritant material.

Abscesses or boils are collections of matter (pus) under the skin or elsewhere, produced in the course of septic inflammation, arising from a contusion, or deep penetrating wound, such as a thorn puncture, and, not infrequently, by transportation of infection from some distant part or parts of the body. It has been said that wounds in animals almost inevitably become infected, and matter (pus) exudes from their surface. The matter consists of the colourless part of blood (serum) containing in suspension the infective germs, and the body cells (phagocytes) which have come to the part to destroy these germs, together with some tissue débris. Matter, or pus, is therefore the product of the tissues dealing with germ infection. Where infection is kept down, as in a clean wound or after judicious use of disinfectants, the amount of matter produced is small. The collections of matter known as abscesses are also sometimes produced by the bites or stings of flies.

Sprains or strains are seen in certain muscles, tendons, and ligaments, particularly those of the limbs, through overstretching or concussion produced by slipping, falling, overwork, or severe blows. They are caused by the tearing up of a number of fibres ; swelling, pain and heat of the parts take place in the attempt at repair. When the attempt is only partially, or not at all, successful, the sprains become chronic.

Fractures, or broken bones, arise also from violent injury ; they may be simple, when the bone is just cracked or divided into two parts ; comminuted, into several parts ; compound, when the fracture communicates with the outside by means of a wound ; complicated, when important structures are damaged as well as the bone. In animals, fractures are usually serious, and it is not often that they heal satisfactorily.

Treatment. (A) Wounds. The treatment of wounds is beset with so many crude and superstitious popular fallacies that the reader must bear in mind clearly a few simple principles to proceed with it :—

(i) At the beginning there is always a certain amount of bleeding from the wound. If it is very profuse, it must be stopped or the animal may bleed to death. This can be done in various ways some of which, such as the tying up of spurting blood vessels, may not be readily achieved by the stock-owner or attendant himself. In an emergency, the best he can do is to plug up the wound first with his hand and then as soon as possible tightly with a piece of clean cloth, or, may be, clean grass, hay, or straw, holding together the edges of the wound firmly over the packing. Packing material of this kind rinsed out of boiling water will check the bleeding sooner and is safer. Depending upon the extent of the bleeding, it will be necessary to leave the packing in the wound for a few hours or a day or longer ; it should be replaced at once, or new packing inserted, if bleeding recommences. The bleeding stops

naturally by the clotting of the blood inside the mouths of the cut blood vessels.

With small superficial wounds, no attempt need be made to stop bleeding, as it will stop of its own accord in a short time. With very small wounds, the blood then clots and later forms hard dry crust, or scab, which effectively protects the wound during the healing process; in these cases no attempt should be made to remove the scab—it is Nature's protective dressing—unless there is good reason to believe that there is matter collecting underneath it.

(ii) After the bleeding has completely stopped, with severe gaping wounds, or, as early as possible, with slight superficial wounds, or deep punctured wounds, in which there is not much bleeding, a careful search should be made for dirt, splinters of wood, glass, bits of metal, or any other extraneous material that may have gained entrance. It may be necessary to search for these bodies for some time in the case of deep wounds or badly bruised wounds, but their complete removal is essential to proper healing of the wound. The material may be removed in various ways—with the fingers, small pincers, a clean piece of wood, or forcibly washing it out, by means of a syringe, depending upon the nature of the material. It does not matter how the removal is done, provided it is complete, and the wound is not unnecessarily further damaged in the process.

(iii) What has to be done next is important to note in that it is often grossly overdone or wretchedly done. It has been said that infection of the wound almost inevitably takes place, except in the very small wounds or scratches that heal under a scab, and also that Nature herself provides the delicate means for the proper healing of the wound and keeping out the infection. It is the impression of many people unversed in this knowledge that an abundant discharge of matter is essential to healing, and its amount is increased intentionally by the application of a variety of substances of most harmful effect in reality, such as caustics, irritants, and vegetable decoctions. The truth is that, as a rule, the smaller the amount of the discharge the better is the healing process taking place.

Certain names are now given to the liquids employed for washing out wounds:—(*a*) *Antiseptic*, properly, a substance that prevents the growth of germs; (*b*) *Disinfectant*, a stronger substance, that kills off the germs; (c) *Deodorant*, a substance that destroys or masks offensive odours. Not all deodorants are by any means strong antiseptics, and many of the proprietory so-called antiseptics with an appealing odour are poor or worthless antiseptics. On the other hand, some of the most powerful antiseptics (such as perchloride of mercury solution) have no odour.

Examples of antiseptics are carbolic acid in one per cent. solution in water, and the somewhat similar chemicals, phenyle, creolin, lysol,

Jeyes' fluid, in rather lower concentration. When they are employed in stronger solution (two to five per cent.), they are disinfectants.

All disinfectants act in virtue of being poisonous towards the germs; they are also, at the same time, poisonous towards the tissues; however, when one uses them on a wound it is hoped that the destructive effect upon the tissues will be more than counterbalanced by the good effect they produce by poisoning the germs. The balance, with many disinfectants, is a somewhat fine one; if they are used somewhat too strong they do more harm to the tissues than they do good by killing off the germs. With many household remedies, the damage done to the tissues is certainly in excess of any possible benefits derived from their disinfectant effect, and, again, others not only do not keep down the growth of germs but actually favour it.

Modern knowledge therefore favours the use of dressings that have the least destructive effect upon the tissues; the most important thing, it is said, is to let the walls of the wound grow in at the fastest possible rate, and assist them in doing so by the use of relatively bland washings, merely to remove dead surface material, and, if it can be achieved without harm to the walls at the same time, keep down the growth of the germs; the tissues in the walls themselves, however, it is again said, have abundant means of keeping down the growth of ordinary germs, provided the wound is merely kept clean and protected from irritation.

For ordinary wounds, that are not "poisoned," in popular language, or infected with virulent germs, in more technical language, it is claimed that the best dressing is frequent washing with simple salt solution. (About a table-spoonful of salt to a quart of water that has been boiled and allowed to cool; Epsom salts dissolved in this way also work quite well.) The salt solution should be employed at about the temperature of the body.

For severe wounds, such as are extensive wounds that have become badly soiled, or are discharging matter very freely, it is advisable to employ something that will act fairly vigorously on the germs, and, also, not diminish the rate of healing. The liquid wound dressings that are now found most beneficial in this respect, after extensive experience in the late War, are one or other of the preparations containing free chlorine gas as the disinfectant. In India, a most convenient form of the material, designated as "Electrolytic Chlorogen" (E. C.) or simply "Chlorogen" has been tried and is sold largely as a proprietory article at present. A small quantity of this liquid added to water, until it smells faintly of the pungent chlorine gas, serves as a good wound dressing. Excellent fluids can also be prepared from bleaching powder (chlorinated lime) or sodium hypochlorite, containing free chlorine in concentrations suitable for wound treatment. The general drawback of these preparations is that they have to be freshly made or kept in a well stoppered

bottle, for if they are exposed to the air for some time the chlorine escapes and they become too alkaline.*

How often should these liquids be applied to the wound? The answer is, as often as possible. If it were practicable to irrigate the wound continuously, taking care that the liquid enters into the deepest crevices and recesses in the wound, it would be decidedly advantageous; and this is the procedure often adopted in hospitals for human patients, affected with severe accidental wounds. Otherwise, the liquid should be applied at least three or four times a day in moderately severe wounds, and for 5 to 15 minutes each time.

The most effective washing can be done by means of a syringe, or of a douche-can from which fluid runs in a gentle continuous stream into the wound through a length of india-rubber tubing. Otherwise if these articles are not available, or cannot be improvised, the liquid can be wrung out of a cloth on to the wound or by gently rubbing the whole surface with a wad of cloth or cotton wool soaked in the liquid, *repeating the process a considerable number of times.*

Other useful disinfectants, now not quite so favoured for wound dressings as they were at one time are :—(*a*) Carbolic acid, or phenyle, one per cent.; (*b*) lysol, creolin, etc.—about one half per cent.; (*c*) potassium permanganate or Condy's fluid—placed in water until it is just distinctly coloured; (*d*) perchloride of mercury, 1 part in 1000 or 2000.

(iv) In addition, the hair round the edges of the wound should be clipped short, with a pair of scissors or clippers, and it is usually recommended that the skin around the wound should be disinfected by rubbing it with some petrol, benzoline, or tincture of iodine. (Care should be taken in applying petrol or benzoline not to run any risk of accidental burning through the proximity of naked lights, as these susbtances are very inflammable.)

(v) Stitching (suturing) of the wound. It is sometimes recommended with large wounds that stitching should be done as soon as the wound

*One of the most useful solutions is Daufresne's modification of Dakin's solution :—

(*a*) Take two large stoppered bottles of about equal size.

(*b*) Bottle No. 1 contains—

Bleaching powder	$3\frac{1}{2}$ ounces.
Cold water, to	$4\frac{1}{2}$ pints.

Mix, shake vigorously, and allow to stand for 12 hours.

(*c*) Bottle No. 2 contains—

Carbonate of soda, dry	1 oz. 5 drams.
Bicarbonate of soda	1 oz. 2 drams.
Water, to	$4\frac{1}{2}$ pints.

Shake, to dissolve.

(*d*) Mix equal parts of the contents of each bottle together; shake well; allow to stand for half an hour; decant off the clear liquid, and filter through several layers of thick cloth.

has been cleaned; when the would has been little soiled and care is taken that it contains no extraneous material, stitching at this time often succeeds. However, in vetterinary practice it is now usually recommended to wash out thoroughly all extensive accidental wounds, in the manner described above, for two days or more, until the amount of " poison " in it has been reduced to a negligible level, before undertaking stitching. This operation had always better be done by a professional man, although in emergency, it may be attempted by the owner using fine pieces of silk thread or other thread that has been boiled or steeped for some time in disinfectant beforehand.

(vi) Dry dressings (18, 19), wound oils (16, 17), and ointments, were at one time very popular, and still have their uses. They are useful, (*a*) in superficial wounds, or abrasions, especially in animals that cannot be frequently dressed ; (*b*) to apply to wounds that are in danger of attack from flies, during the intervals between the washings ; (*c*) in punctured wounds, particularly of the feet and extremities, that are in constant danger of contamination from dirt.

(vii) Bandages, made of cotton or linen cloth, can be applied with much advantage to cover wounds of certain parts, such as, of the limbs, or tail, during the intervals between the dressings, and to keep off flies, they may be smeared with tar, camphor, or other repellent.

(B) CONTUSIONS, BRUISES, ABRASIONS, SORES. The same general remarks apply to these injuries. Bruises and sores, commonly caused by the yoke in working cattle, should be treated as early as possible, for neglect of a small bruise may lead eventually to the production of a large festering sore that will lay up the animal for a long time. The general principles of treatment in injuries of this kind are :—(i) Ascertain the cause of the trouble and remove it. For example, if it is badly fitting harness, remedy the defects in the fitting. (ii) Rest the animal at once, if the bruise is aggravated during work. (iii) Treat the sore, by thoroughly cleaning the surface as described for wounds, and keep it clean by repeating the treatment twice daily. When the wound is healing, or the injury affects only the skin and not the deeper tissues apply a hardening lotion, such as country spirit, or " white lotion."* A good plan is to dust the bruise over after each bathing with a dry dressing (18).**

With severe contusions, caused by blows or falls, there may be much swelling, and bruising of the deeper tissues, under the skin. The animal

* "White lotion " is made up by dissolving 3 drams each of lead acetate and zinc sulphate in a pint of water.

**The cattle-owner is advised strongly not to resort to the use of the firing iron in dealing with common injuries, such as contusions, abscesses and sprains. Healing is generally greatly retarded by its use, through the extensive damage done to the tissues. Besides, it has often for its effect merely the changing in appearance of the injury, so that it becomes difficult to detect and deal properly afterwards with the original and real source of trouble in the part.

should be rested, and the part gently massaged, employing also fomentations with hot water or applications of very cold water. Afterwards, an embrocation or liniment (20) should be rubbed into the skin, for about half an hour or so, twice or three times daily.

(C) ABSCESSES may be superficial or deep. When they are superficial and are ripe, they are easily detected by their fluctuating texture to the touch; they may be accompanied with much pain and heat during the earlier stages, before they are quite ripe. Afterwards, they have a tendency always to burst through the skin and discharge yellow matter (pus). Treatment consists in opening them as soon as they are ripe, if they are not already open, and, in any case, the opening should be wide enough to allow the pus to discharge freely. The interior should then be treated in exactly the same manner as has been described for wounds:—thorough washing, preferably with a syringe, and protection of the interior from dirt and flies. Small abscesses or boils, as a rule, heal quickly. Special attention has to be paid to them, however, when they are situated in parts exposed to irritation, as at the places covered by harness, on the limbs, or on the breast.

(D) SPRAINS or strains of the muscles or tendons require careful and early treatment, especially in working cattle. They can be detected, when they affect a limb, by lameness of the affected limb, and on closer examination swelling and tenderness of the sprained part. Treatment consists in resting the animal completely. Often no more is required, and the animal may be put to work again in a few days, if it has been rested early. In neglected or severe cases, the period of rest required may, however, become very long. In these cases, the affected part should be treated by plentiful application of very cold water, or fomentation with hot water. In addition, the part should be well massaged, either with the application of an embrocation (20) or by simple rubbing. Sometimes, hot poultices of bran or linseed are recommended, and, if changed frequently, they may well take the place of hot fomentations. Tight bandaging of the sprained part, when it is in the lower part of the limbs, is an additional beneficial means of treatment.

(E) FRACTURES, OR BROKEN BONES. Unless the fracture is a simple one, and in a fairly young animal, treatment is not likely to be very successful. In such cases, the broken bone can be immobilised by placing over it splints, of wood or strips of strong bamboo cane, and tying them down with strong bandages. Among communities where destruction of animals to relieve them of their misery is proscribed, there is no doubt that success would often attend proper amputation of limbs in case of compound and complicated fractures. This class of work, however, should always be undertaken by a professional expert. A common form of fracture which demands treatment is that of the horns; horn injuries are specially treated below.

Horn injuries.

The common injuries of the horns are separation of the horn, cracks or fissures of the horn, and fractures.

(i) *Separation of the horn.* The horn is separated from its core by violence, such as occurs in fighting, or by persistent irritation, as in working cattle, in which the loss of the horn may diminish considerably their utility. Otherwise, the loss is seldom serious, and new horn is soon formed, which never, however, has the same quality and sppearance as the original horn. Treatment consists in washing the exposed core, and the application of disinfectants to it as in the case of other wounds. To protect it against flies and dirt, it should be sprinkled over with a dry dressing (18), and covered with a bandage, which is then smeared over with tar. Sometimes, the horn does not become detached at once, but is merely loosened from the core.

(ii) *Cracks of the horn.* Cracks are also caused by violence, often by blows from a stick. The crack may take place in the horn covering or in the horn core, or in both. When the crack reaches the surface, blood oozes from it usually sooner or later. If the core only is cracked, the only signs of injury are heat and tenderness in the part, and bleeding may also take place into the chambers within the skull. When the horn-covering only is cracked, recovery takes place with proper treatment quite readily. The bleeding should be stopped by application of very cold water, and the crack then dressed with antiseptic and astringent lotions (15, 19).

(iii) *Fractures.* These are also caused by violence; the horn may be broken right through or only partially across. Treatment will depend largely upon the site and upon the extent of the fracture. Partial fracture of the extremity of a horn is treated by amputating the horn with a fine saw just below the seat of the fracture; the free end is then dressed with a disinfectant and bandaged. If the fracture is complete, but irregular, it is well also to amputate the horn just below with a saw. When the fracture is partial and towards the middle or base of the horn, an attempt may be made to immobilise the broken part by applying splints; it often becomes necessary, however, to amputate the horn. If horn fractures are not properly treated, matter (pus) may collect subsequently in the chambers of the skull (the frontal sinus).

Horn Cancer.

Cancer of the horn core is relatively very common among Indian cattle, and appears to be associated in its origin largely with the irritation set up in the structure by working conditions, chafing of ropes, rubbing, fighting, and excessive treatment of injuries with tar and other products. If the cancer growth affects the core only, at some

distance away from the skull, treatment can sometimes be successfully undertaken by amputating the horn well below the diseased part. The exposed end of the stump is then lightly touched with a hot iron to stop bleeding, and is afterwards treated as a simple wound. A procedure recommended (STIRLING) is to wash it daily for seven days with a saturated solution of Epsom salts, followed by a dry dressing of dehydrated Epsom salts, and the application of a bandage. After seven days, the dry dressing to be applied until healing takes place is composed of equal parts of powdered charcoal and sugar.

It has been found, unfortunately, that in all but the mildest cases of horn cancer, the disease shows an obstinate tendency to recur, and after two or three attempts at excision of the growth, mortification of the bones of the head takes place, and the animal becomes incurable.

CHAPTER XXIX.

DISEASES OF THE FEET.

NAME.—Hind.—*Bimari-ê-khur.*

Diseases of the feet are not so common or important in cattle as they are in horses, but neverthelses, cattle are susceptible to various foot diseases which include nearly all those seen in horses together with some other diseases, which will receive passing notice here.

(*a*) *Foul in the Foot.* This is a disease of the interdigital space, that is, the tissues in the cleft of the hoof. It is caused by an injury to the skin of the part, and is often seen as a " boil," with a core of dead tissue. Sometimes, there occurs what is called " contagious foul of the foot," when several animals in a locality are infected; this disease is caused by the presence of a specific germ (apparently the necrosis bacillus) in the soil or litter, and the same measures have to be adopted to avert its spread as have been recommended generally for contagious diseases. The symptoms of foul in the foot are severe inflammation between and around the claws, with, later, the formation of an abscess and discharge of fœtid matter (pus). Intense lameness with loss of condition, is produced; in bad cases the disease spreads upwards to the joint and to the tendons of the foot. The treatment recommended is the same as for a septic wound: opening of the abscess if it has not already burst; careful removal of the dead core; washing the wound frequently with an antiseptic (15, 16, 17); placing the animal on a dry hard standing; care should be taken to exclude flies, when they are prevalent, by wrapping the wound with a bandage smeared with tar.

(*b*) *Foot-and-Mouth Disease.* This disease has been dealt with in Chapter VI.

(*c*) *Dermatitis,* or inflammation of the skin. Simple inflammation of the skin in the hoof cleft is common in cattle, and is caused by the action of dirty litter, mud, and other irritants. The skin becomes red and swollen. and the an'mal is more or less lame. Treatment consists in bathing the part two or three times daily with an antiseptic lotion, or, merely, salt and water; drying; standing the animal on a dry surface; applying an antiseptic or astringent dry dressing (18 or 19).

Sometimes, with constant action of the irritant for a long time, the skin within and in front of the claws becomes much thickened, and covered with wart-like growths or granulations. In the beginning there is lameness, which disappears after a time, to reappear later, when the growths have reached such size as to push apart the claws when the animal is walking. Treatment consists in cutting away the growths with a knife or pair of scissors, or searing them off with a red-hot iron

lightly applied ; powdered sulphate of copper is then rubbed in to stop the bleeding, and its application repeated from time to time. The animal should be cast and well secured for this operation.

(*d*) *Acute Laminitis.* This condition is one of intense pain and inflammation inside the hoof, with general symptoms of high fever and loss of appetite. It is generally seen in oxen after long, fatiguing journeys. One fore foot or both fore feet, or both hind feet, or all four feet may be affected. This disease is usually less severe as it is seen in cattle than in the horse. When the two fore feet or all the feet are affected the animal stands with the fore legs well in front of the body, and the hind legs well under the belly, so that the weight comes on the heels, and not on the walls in front of the hoofs, the tissues under which are severely inflamed. When the animal walks, it displays a peculiar attitude, as if it is taking great care how it places its feet on the ground, which it does by placing the heels down first. At the commencement, there is a diffuse swelling of the leg above the hoof ; the claws, and more especially the inner ones, feel hot and are very tender on tapping. In very severe cases, the upper part of the hoof commences to separate from the foot after a week, as is shown by the oozing of a yellow liquid at the top of the claws ; the separation, as a rule, however, does not extend far. On recovery, there is likely to be some deformity, caused by the animal tending to throw its weight more on the outer claws. Treatment is difficult. The animal should be put on a very light diet, given a strong purge (2 or 1), and placed on a soft clean floor of clean sand or soft straw. If separation of the horn occurs, the fissure should be frequently washed with an antiseptic (15), and if flies are prevalent covered with a bandage smeared with tar.

(*e*) *Sand-crack.* This is a disease in which there is a crack or fissure running down the front of the hoof, commencing from the coronet, or soft tissues, above ; transverse cracks are also fairly common in the fore feet. The crack may be of varying depth, length and age. When it extends down to the soft tissues of the hoof there is an oozing of liquid, often blood, from the crack, accompanied by marked lameness. In cattle, cracks are more common in the fore feet, and on the outer aspect of the feet. The chief cause seems to be the pressure put on the foot in pulling a load especially when the texture of the horn is dry and brittle, and the weather dry. Treatment consists mainly in cleansing the crack and washing it with a strong disinfectant ; if lameness is very pronounced, it may be advisable to pare down the wall so that dirt and matter can be readily removed, with each application of the disinfectant, from the crack. After cleaning, the crack should be filled with tar, and a bandage applied, when possible.

(*f*) *Bruising of the Sole.* Bruises, or contusions, of the sole are caused by long journeys on hard roads, especially in unshod oxen, or

in oxen with very thin shoes, or in those with shoes that are convex on the upper surface. The symptoms are lameness in the affected foot or feet; lying down always when left alone; holding the affected limb in front of the other one. The seat of the trouble can be detected by feeling the foot and tapping it, and by paring down the sole to discover signs of bruising, which, when present, are revealed by bloody discoloration of the horn and exudation of a yellowish liquid from it. When the disease has been neglected, there may be extensive underrunning of the foot with matter and gradual separation of the hoof from the foot, leading eventually to shedding of the hoof. In slight cases of foot-soreness it is sufficient to rest the animal on soft land or on soft dry litter, until it recovers. When the sole has become underrun with matter, it should be pared down so as to expose the whole of the underrun part, or, at any rate, allow the matter to escape freely; the exposed part should then be covered with a layer of tow covered with tar, and bandaged if possible; the dressings should be frequently renewed, Blistering of the coronets is sometimes recommended.

(*g*) *Wounds.* Wounds are caused by pricks in shoeing, picked-up nails or pieces of glass, sharp stones, or other pointed objects. In cattle, injuries of this kind occur often in the cleft between the claws. Pricks in shoeing are common in cattle, because of the thinness of the wall of the hoof. If the nail is withdrawn immediately, often no further trouble is seen, but if it is left in or if infection has got into the wound, a severe inflammation may arise. The symptoms in wounds of the foot are lameness and local inflammation, the extent of which depends upon the precise seat and depth of the injury and the kind of infection introduced. It is not rare for lockjaw (tetanus) to be contracted in this way. In an ordinary case, the treatment is, unless the cause of the injury is discovered in the cleft, to pare the sole to discover the seat and cause of the injury; remove the cause of the injury, such as a nail or glass that has perforated the soft parts; pare away the sole so as to allow matter freely to escape, and then pack with tar and tow, as described above in Bruising. If septic inflammation has extended to a joint or to the bone, it is recommended that the claw should be amputated, with surgical precautions. Sometimes, pronounced lameness is caused by a small object becoming lodged between the claws, without setting up a bruise or wound.

CHAPTER XXX.

SKIN DISEASES.

NAMES.—Hind.—*Kharish ; Khujli.*

Stock-owners recognise the state of health of an animal readily by the condition of the skin or " coat" ; in a healthy beast the coat is glossy, well set down, and whorled here and there in patches caused by the animal licking it ; in an unhealthy or " unthrifty " beast, the coat is rough, with the hairs standing erect, and not whorled by licking, and the skin is tightly adherent (" hidebound ") to the tissues underneath. This condition of the skin has been often mentioned in enumerating the symptoms observed in many diseases in the preceding chapters ; it is not in reality a disease of the skin, but a symptom of disease elsewhere in the body.

In some specific diseases there occur sometimes peculiar alterations in the skin, as in cattle plague, somewhat uncommonly ; in foot-and-mouth disease, in the skin of the feet and lips ; in blackquarter, where there is a mortification of the skin over the affected part ; and, in cow-pox, where there is an eruption on the skin of the udder and teats.

There occurs, however, a large variety of affections where the skin is affected primarily or most conspicuously. These diseases are caused mainly by parasites, vegetable or animal ; not uncommonly, however, they are caused by inert materials or poisons. On the whole, it may be said that cattle are not seriously beset with skin diseases, in the same manner as are dogs, sheep, or even horses and camels.

The common skin parasites of cattle are :—Ticks, very prevalent ; flies, biting and non-biting (which exert their deleterious effects mainly through maggots in wounds or sores) ; lice ; mange mites ; ringworm moulds ; certain bacterial germs, such as those of infectious lymphangitis, acne, or necrobacillosis (calf diphtheria) in calves. The affections produced by ticks have been dealt with in the chapter devoted to tick-fever, and those by flies and lice in the chapter on Insect Diseases.

MANGE. Mange, or itch, (Hind.—*Khujli* ; or *Kharish*) affects all the domestic animals, in various degrees of severity. It is not such a serious affection in cattle as it often is in some other animals (sheep, dogs, horses), but in India cattle mange is very widespread, especially among buffaloes. It shows a tendency to appear spontaneously in these animals at certain seasons of the year, and then disappears.* The animals worst affected are generally those in poor condition. It

* At Muktesar, it is observed among buffaloes for eight or nine months of the year, and then disappears from May till August.

may affect any part of the body, but very common sites are the inside and back of the thighs, and sides of the neck. The symptoms are considerable itching, with licking and rubbing the parts. At first, small nodules or pimples appear on the skin, which soon becomes hairless; the skin then becomes covered with scabs, and later dry, scaly, wrinkled and thickened. The affected patches extend in size, and with the extension the animal gradually loses condition.

The mange mites of the various kinds of animals are alike, but differ in that those of one species of animal cannot thrive for long on another. They are small creatures which are barely visible to the unaided eye, and belong to the same class of the animal kingdom as spiders and ticks. Some of them (the sarcopts) burrow into the skin and lay eggs in the galleries they make; they are difficult to reach with medicines. Others (the psoropts) live on the surface of the skin. The common buffalo psoropt takes from six to eight days from the time it hatches from an egg till it becomes an adult male or egg-laying female; the female survives somewhat under ten days on the body, and during this time lays 17 or 18 eggs. The eggs are more resistant than the other stages, especially to the action of drugs. They cannot, however, live apart from the body for longer than seven days.

Treatment of mange in cattle is not a very difficult matter, and there are several indigenous remedies, such as taramira oil, which serve quite well when properly applied. Sulphur preparations are now generally believed to be the best. Suitable prescriptions are 13, 14, and 15. Ten per cent. creosote in olive oil is also good. Before applying the remedy the affected part should be thoroughly washed with soap and water to remove all the loose crusts and grease so that the remedy can easily penetrate the skin. The remedy should then be rubbed in well, taking care not to treat more than a quarter of the whole body surface at one time. In seven or eight days, the part should again be thoroughly washed with soap and water, and the dressing repeated. Two successive treatments of this kind are usually necessary.

Ringworm. This disease is particularly common in young animals, and affects chiefly the head, face, lips, and neck. It commences with the appearance of one or several raised circular patches, on which the hairs stand erect; the round area then changes into a dirty-white crust, about the size of a rupee-piece. When the crusts are numerous, they may join up to form large areas of scabby surface. The crusts are, as a rule, firmly adherent; later, if left alone, a small amount of matter oozes out from underneath them. These crusts contain the mould or fungus which is the cause of the ringworm and attacks especially the roots of the hair. The disease is contagious, and is readily transmitted to other cattle and sometimes to human beings. Loss of condition is roduced in young cattle badly affected. The degree of irritation is usually slight.

Treatment is simple. It suffices to apply the same kind of dressing as for mange, or, much better, one of the iodine preparations:—tinc-

ture of iodine, painted on and around the crusts; biniodide of mercury ointment (one part of the powder in 50 parts of vaseline or lard). Care should be taken to burn all crusts and fallen hair, to prevent the spread of the contagion.

ACNE. A form of acne, boils, or heat spots, commonly affects the end of the tail in cattle, and is caused by a microscopic bacterium (staphylococcus). In some localities it shows a considerable tendency to spread among the animals, and its spread is caused by infected dung and litter. The end of the tail becomes swollen, red, hot, and very sensitive; the hair falls off; the skin becomes knotty, and small abscesses then form on it. The disease may eventually progress to such an extent that the affected part becomes mortified and drops off.

Treatment is the same as described for wounds. In the early stages, sulphur ointment is said to be very good.

INFECTIOUS LYMPHANGITIS. This is a disease that appears in enzootic form in certain parts of India and is caused by a microscopic germ (a streptothrix or a bacillus) that penetrates the skin either through a small wound or by the bites of certain insects, probably lice. The disease is manifested by cording of the lymphatics under the skin, swelling of the lymphatic glands, and the development of numerous small abscesses, which eventually burst and discharge a cheesy, hard matter. When the condition affects the limbs, lameness is often evident, but otherwise the only general symptom usually seen is wasting. The disease shows a tendency sometimes to disappear and then recur. Treatment is difficult; it has been claimed recently that it can be cured by specific vaccine treatment and so when the disease occurs in their herds stockowners are advised to consult professional experts for treatment.

ECZEMA. Eczema, in its various forms, is well known in human beings and dogs. It is a non-parasitic skin disease, usually of very obscure origin, although dietetic disturbances are claimed to contribute largely towards it. There is a peculiar form of eczema of not uncommon occurrence among cattle, especially in hot countries, and is caused by the eating of certain foods—lucerne, clover, trefoil, buckwheat, etc.—which appear to contain a principle that is excreted by the skin and is acted upon by the direct rays of the sun so as to set up some property that causes intense irritation in the surrounding tissues. The condition affects cattle particularly that have white skin (not necessarily, white hair), and in animals such as Holsteins, the white areas may become inflamed and scabby, while the adjoining black areas remain unaffected. Treatment consists mainly in prevention: avoidance of the food (with the so-called photo-sensitive principle); avoidance of bright direct sunlight when possible. The affected areas should be treated as has been indicated for Bruises and Sores.

There are several other conditions, of so-called erythema or dermatitis, in cattle. Erythema, or reddening of the skin of the udder often takes place by chafing against the thighs. Dirt, stings of bees and wasps, and the awns and prickles of certain plants, are among the causes of inflammation (dermatitis) of various kinds. On the whole, they are not of great consequence. The kind of inflammation caused by mechanical injury—harness galls, etc.—has already been dealt with in treating of Bruises and Sores.

CHAPTER XXXI.*

INSECTS AND DISEASES OF CATTLE.†

NAME.—Vern.—*Bimarian jo gaibhains meṅ chhote kiṛon ke zarie se paidā hoti haiṅ.*

Diseases of cattle caused *indirectly* by insects have been considered in the foregoing chapters. Diseases of this class are caused not by insects themselves but by various microscopic germs (bacteria, protozoa, worms) *carried* by the insects. Notable examples of such diseases are afforded by surra and (sometimes) anthrax.

In what follows a brief account is given of the more important diseases caused by insects themselves.

(*a*) DERMATOSIS, caused by the attack upon the bodies of animals by lice, is of common occurrence. Two kinds of lice are met with, namely, the Biting Lice and the Sucking Lice. The trouble caused by the former—which are not blood-suckers but mainly live on epidermal scales and exudations from the skin—is largely that of irritation which leads to much loss of condition. As regards the Sucking Lice, apart from the irritation they cause, they must be regarded as a potential source of disease in view of their blood-sucking habits.

For the control of lice, raw linseed oil has been used with very satisfactory results, a pint of the oil being sufficient for from four to five cows. The oil is best applied with a brush. The following directions, as recommended by Lamson in the United States of America, should be observed to avoid danger of the oil scurfing or burning the skin :—

Do not rub the skin too vigorously when applying the oil. Do not allow the animals that have been treated to go out in the strong sunlight until at least twelve hours after applying the oil. Do not use the boiled or refined linseed oil.

Clipping the animals prior to application of the oil is not recommended, as clipped animals are liable to suffer considerable scurfing as a result of the oil reaching the skin quickly.

Of the various sprays, a four and one-half per cent. solution of creolin will give good results.

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* This chapter has been written by Mr. S. K. Sen, B.A., B.Sc., of the Muktesar Institute.

† For a clear understanding of the rôle played by insects in the causation of disease, some knowledge of the biology of insects is necessary. The following primer is recommended for study :—

CARPENTER, G. H. The Life-Story of Insects. Cambridge : The University Press. 1913. 134 pp.

(*b*) MYIASIS. This is a term applied to the invasion of man and animals by the larvæ, or maggots, of flies. The following are the principal types of myiasis affecting cattle :—

(i) *Subcutaneous Myiasis.* This form, which is of very common occurrence, refers to the condition induced by the presence of larvæ in subcutaneous tissues, such as in wounds and sores. There is a gradual tearing away of the tissues by the larvæ, accompanied with purulent discharge. Cases of myiasis of this type are associated with the violation of sanitary principles, such as the lack of adequate arrangements for the disposal of carcases which serve as material for the breeding of the majority of the species of myiasis-producing flies.

As to treatment, the expulsion of the larvæ from within the wounds is brought about by the introduction of a suitable insecticide, such as chloroform. The drug is poured into the wounds which are then closed up. This benumbs the larvæ which are then extracted with forceps. After the larvæ have been thus taken out, the wounds are dressed and pine-tar applied to the outside to repel flies.

(2) *Warbles.* Warbles in cattle, caused by the presence of larvæ of the so-called " heel-fly " (*Hypoderma*) beneath the skin or the back, although of relatively minor importance from the standpoint of disease, constitute a source of great economic loss to the cattle-owner owing to the depreciation of the value of hides which become " grubby ", *i.e.*, perforated with holes at the points where the grubs have emerged from beneath the skin.

The question of controlling warble flies has not been sufficiently worked out to make satisfactory recommendations. The most feasible method as yet devised is to squeeze out the grubs from the tumours, care being taken not to damage them in the process of extraction, as their body juices contain substances which are poisonous for cattle. After extraction, the grubs should be destroyed to prevent them from developing into pupæ.[1]

[1] In Europe, Associations have been formed to cope with the problem of controlling this destructive parasite.

CHAPTER XXXII.

POISONING.

NAMES.—Hind. *Zahr Kurani.*

Cattle are common subjects of poisoning, which may be roughly classified into the following kinds :—(i) Poisoning caused with malicious or criminal intent; (ii) Poisoning caused accidentally, by swallowing dangerous substances left inadvertently within reach of the animal, or mistakenly given to the animal; (iii) Poisoning caused by feeding on certain plants and food substances containing poisonous qualities; (iv) Poisoning caused by snake bite.

(i) MALICIOUS OR CRIMINAL POISONING. In some localities *chamars* and others regard the hides of animals as their special perquisite, and satisfy their covetousness by various means: tempting animals with succulent food containing poisons; or, even, spreading cattle plague and other infectious diseases. Arsenic seems to be a very convenient poison for administration in this way. In certain parts of India, it seems that *chamars* resort most frequently to criminal poisoning of cattle by introducing into the rectum small spikes (*suis*) impregnated with the crushed seed of the leguminous plant *gūmchi* (*Abrus precatorius*), which contain the extremely poisonous principle *abrin.* The symptoms then set up closely resemble those of blackquarter, and so *chamars* are particularly tempted to resort to their nefarious practices when blackquarter is already present among the cattle of a village.†

(ii) ACCIDENTAL POISONING. This is somewhat frequent in cattle on account of their tendency to eat or lick all kinds of odd substances placed within their reach; for example, disinfectants (phenyl, etc.) left in pots; newly painted posts or doors, covered with lead paint; weed and vermin killers, containing arsenic, and sometimes phosphorus or strychnine.

To the above may be added overdosing with certain medicines, especially proprietary medicines, to improve condition. The cattle-owner is especially warned against this practice; no medicines can remedy defective feeding, and most of them do harm. With certain medicines, such as croton oil, the greatest care should be exercised, because of their intensely irritant properties. Most of the drugs used as medicines are poisonous when given in excess of the doses laid down for treatment.

† *See* STIRLING. Poisoning by *Gumchi* or *Suis* (Needles).—*The Veterinary Journal,* 1924, Vol. 80, p. 473.

With the simple mineral poisons the symptoms are somewhat similar: intense gastro-enteritis, with severe abdominal pain, great thirst, foaming at the mouth, diarrhœa, often with blood in the dung and sudden death. Death may, however, often be protracted, as in chronic lead poisoning. Acute nervous symptoms, with apparent madness, blindness, and twitching of the muscles may also be seen. Cases of this kind occurring suddenly should always be regarded with suspicion, and professional and police aid sought to elucidate the cause, unless it can be readily discovered as having been caused by accident.

Nux vomica (or its alkaloid, strychnine) sets up violent nervous symptoms: violent spasms of the muscles with curved back; death may occur from suffocation after a few spasms.

Coal tar disinfectants (phenyl, cresol, etc.) set up symptoms somewhat similar to those caused by strychnine, with great weakness.

Opium (or morphia) in the ox causes symptoms of excitability at the beginning: walking in circles; butting into obstacles, with the general appearance of madness. This stage is followed by one of *drowsiness, unconsciousness and death.*

The treatment appropriate for the various kinds of simple poisoning vary somewhat with the nature of the poison and the stage of the attack. In all cases, it is advisable to administer a purge (1), and if there is marked tympany to treat it as indicated in the chapter dealing with this condition. This should be followed by the administration of a plentiful supply of rice or linseed gruel. If the animal is suffering from convulsions, as in strychnine poisoning, an anodyne (9) should be given. If it is suffering from intense drowsiness, it should be given stimulants (3).

(iii) Plant Poisoning. In countries where stock raising has made rapid progress within recent years, such as the United States of America, South Africa, and Australia, it has been found that the ill-effects caused by injurious fodder or weeds to cattle merit very careful study and attention; live-stock poisoning in these countries thus forms now an important branch in the study of the prevailing animal diseases. In India our knowledge of this branch of study is still very defective, but we have nevertheless some precise information upon it that ought to be placed within the reach of the stock-owner. The following information is compiled from notes kindly received on the subject from an experienced authority * on the forage plants of India :—

1. *Young Jowar plants.*** Jowar is a crop largely cultivated for fodder in Northern India; it is usually sown in the hot weather, before

* Dr. W. Burns, D.Sc., Joint Director of Agriculture, Bombay Presidency.

** For fuller information on this subject, the reader should consult (i) C. Somers, Taylor and M. N. Ghosh. Cattle Poisoning by *Juar* (*Andropogon sorghum*) and its Prevention.—*Agricultural Journal of India,* 1916, Vol. XI, Part IV, p. 377. (ii) M. N. Ghosh. Notes on the Hydrocyanic Content of *Jowar* (*Andropogon sorghum*).—*Ibid.,* 1919, Vol. XIV, Part I, p. 107.

the rains; the stalks are cut while green, before the ears are formed, for fodder. Experience has shown that very young plants and those which are stunted in their growth are dangerous, and recent investigations have proved that the danger resides in a certain chemical constituent—a so-called glucoside, known as *dhurrin*—which on fermentation splits up into a number of simpler compounds, one of which is the extremely poisonous chemical called prussic acid. It has been estimated that five grains of this acid, given in a single dose, are enough to kill an ordinary beast, which can eat easily as much as 60 pounds of jowar in a day.

In certain analyses of jowar that had given rise to an outbreak of poisoning in Bihar, this quantity of fodder was found to yield 30 grains of prussic acid, or enough to kill six beasts. The quantity of prussic acid rapidly diminishes as the plants reach maturity, and in a normal year there appears to be no danger after the plants have become two months old. It seems that the weather has a most important influence in causing the plants to retain or accumulate the poisonous properties, and outbreaks are observed particularly during years when the rains are considerably delayed; jowar crops, especially those grown on dry lands, are then likely to be very dangerous, before the advent of the rains; they become safe later soon after the rains break. The poisonous principle is found chiefly in the stalks during the first three or four weeks of the plant's life; it then rapidly disappears from the stalks, and persists in the leaves, in decreasing quantities, until maturity is reached. This explains why goats are not so susceptible to poisoning with the very young plants, as they eat only the leaves. The crops in adjoining fields may yield very different amounts of the poison. The acid juices of the young plant favour the action of the ferment which liberates the poison.

Sun-drying of the plants does not render them harmless, for as soon as the dried plants are again soaked in water the ferment sets the poison free; perhaps, if the dried plants were soaked for a long time in water, the poison would escape into the air, and the food would then be safe. It has been shown, however, that storage of the green plants in a silo is a good method of making them safe, for during the process the poisonous principle (glucoside) is broken up, and the poison escapes. It seems that storage in this way for three weeks is sufficient.

2. *Poinsettia pulcherrima:* a common ornamental plant in the Bombay Deccan. This plant belongs to the natural order Euphorbiaceæ. The plants of this order contain a milky juice, which has an unpleasant taste and may be poisonous in some species.

3. *Jatropha curcas:* a wild plant, belonging to the same order. The seed is undoubtedly poisonous and is said to be used for the criminal poisoning of cattle.

4. *Vinca pusilla :* a weed of pastures; reported to have caused drowsiness in cattle and buffalœs (Godhra, Bombay Presidency), from which they recovered in two days. Sheep and goats are also said to be susceptible. Rabbits fed by Dr. Burns on this plant mixed with grass did not show definite symptoms of poisoning.

5. *Acacia tomentosa :* a jungle tree. Pods are said to cause drowsiness and salivation (Godgra). (Analysis on two occasions revealed 0·108 and 0·045 per cent. of prussic acid; rabbits fed on these pods showed no ill-effects.)

6. *Datura fastuousa :* a weed. The seeds are used for criminal purposes both for poisoning human beings and cattle.

7. *Calotropis gigantea :* the juice is said to be introduced into the rectum to cause inflammation.

8. *Abrus precatorius :* a jungle plant. The powdered seed is said to be introduced under the skin by professional poisoners.

9. *Nux vomica :* a jungle plant. The seeds contain the very powerful poison, strychnine, and they are said to be used for poisoning.

10. *Ricinus communis* (Castor plant) : a cultivated plant. The seeds contain the very powerful poison *ricin,* which is known to produce acute inflammation of the bowels in cattle. They may be found accidentally among other foods, or in oil-cakes.

11. *Nerium oleander* (Oleander plant) : grown for ornament near water channels. It is undoubtedly poisonous and is said to have caused deaths among cattle.

12. *Withania somnifera, Gloriosa superba,* and *Anamirta paniculata :* all said to have caused symptoms of poisoning; the root of the second-named plant is undoubtedly poisonous.

Dr. Burns further adds that he has had brought to him on several occasions plants said to have caused poisoning in animals (cattle, horses, camels and goats). On investigation, the plants proved to be absolutely harmless. In such cases, it is likely that the poisons may have been administered or absorbed otherwise, and the person in charge of the animals merely fixes on the first available thing as the presumed cause of the poisoning. Reports of poisoning have therefore to be treated with the greatest possible scepticism, until the causal connection between the plant and the symptoms is clearly established.

(iv) SNAKE BITE. Other affections, notably blackquarter and anthrax, are often attributed by owners to snake bite, and they should take care not to put down all cases of sudden death, especially those with marked local swellings, to snake bite. In an animal affected with snake bite, one may notice, if the animal is seen soon after the bite, that it is in a state of excitement, and signs of local pain and irritation may lead to the discovery of the punctures inflicted by the fangs; the punctures may be bleeding. Later, a swelling, varying considerably in

size and usually quite soft develops at the seat of the bite. This swelling in most cases can readily be distinguished from that of blackquarter. Next, signs of great pain, quivering of muscles and nervous excitement are seen, resembling those of spasmodic colic ; death generally occurs from suffocation. Death may occur within a few hours, when no marked swelling will be noticeable, or in a day or two. Animals that recover are affected with marked dullness and depression.

Treatment consists in locating as soon as possible the seat of the bite, opening it up freely with a knife, by cutting an incision into each fang mark about half an inch in depth, and rubbing into the flesh some crystals of potassium permanganate or chlorinated lime. If the bite is low down on a limb, a piece of bandage or rope should be wound tightly round the limb above the bite.

CHAPTER XXXIII.

DISEASES COMMUNICABLE FROM CATTLE TO MAN.

From the number of diseases briefly described in this little book, it might be inferred that the ox is a very sickly beast, and a danger to man. The truth is that the products of cattle, particularly the milk, are of the greatest value to the welfare of man, and the amount of disease communicable from them to man, in India particularly, is almost negligible. It has been well said by a great authority on this subject in England that, if tuberculosis were excluded from the count, the mortality among human beings in Great Britain caused directly by animal diseases would amount in the year to less than those caused by, for example, lightning. Cattle tuberculosis is, indeed, a very serious menace to the health of man, but, as we have seen in the chapter dealing with this disease, it is of very small, though not quite negligible, account in India, at the present time. A number of diseases may be transmitted indirectly, by eating diseased cattle meat, but probably the importance of these diseases has been often much exaggerated in the past. Cases of so-called " food-poisoning " in man are caused by certain, now well-known, microscopic germs, which most often gain access to the meat during preparation or storage ; sometimes, they develop in carcases of animals that are fevered or are carriers of these germs. There is a certain tape worm (*Tœnia saginata*) of man contracted by eating cattle flesh containing the cystic stage of the worm ; it is easily destroyed, however, when the meat is well cooked. Anthrax is undoubtedly sometimes transmitted to people such as slaughtermen handling the carcases of diseased animals. Cow-pox may be transmitted to milkers and others, but it is a very mild affection. In India, it is not impossible that the disease known as undulant or Malta fever is transmitted occasionally by drinking unboiled cows' milk in certain localities : the disease has been well identified in goats and men in the country. The somewhat similar micro-organism of contagious abortion is very prevalent. However, the indigenous custom of boiling all milk prior to consumption precludes the spread of infection, if it does exist, in this manner. It must be noted, nevertheless, that the boiling of milk prior to consumption is not entirely a salutary process, for modern knowledge has shown that certain essential and elusive food qualities, known as vitamins, may be destroyed in the process.

Cases, or even outbreaks, of serious epidemic disease, such as typhoid, diphtheria, cholera, have often been laid to the charge of milk. It is very likely that in many cases the food at fault was the milk consumed,

but, nevertheless, in the very great majority, if not quite in all, of these cases the milk must have become contaminated after it left the cow, either from the bodies of milkers or attendants who were "carriers" of the specific infections, or from infected vessels or other implements used in dealing with the milk. Where a dairy herd is being maintained for the production of milk for consumption by human beings, and especially by children and invalids, the greatest care should therefore be taken to ensure that the milkers are healthy and the utensils employed maintained in a state of scrupulous cleanliness and frequently sterilised.

APPENDICES.

I. Prescriptions.

The following prescriptions may be found useful when professional assistance and the equipment of a veterinary dispensary are not within reach. Most of the drugs can be obtained in villages. Epsom salts and phenyl should form part of the equipment of all owners of stock. They can be obtained in towns and large villages.

The doses prescribed are for full-grown cattle and buffaloes of 500 lb. and upwards. They should be reduced in the case of small and young animals according to weight and age. Unless otherwise stated, one-sixth doses may be given to full grown sheep and goats.

WEIGHTS.

1 dram	= three two-anna pieces.
3 drams	= 1 tola or 1 rupee.
1 ounce	= ½ chittack or 2½ tolas.
1 pound	= 8 chittacks or ½ seer.
1 seer	= 16 chittacks or 80 tolas.

MEASURES.

1 fluid ounce . . .	= ½ chittack.
1 pint	= 10 chittacks.
1 quart	= 20 chittacks or 1¼ seers.

PURGES.

1.

Epsom salts	1 pound.
Powdered ginger (*sonth*)	½ ounce.
Powdered sulphur (*gandhak*)	2 ounces.
Treacle (*sheera*)	8 ounces.

Mix together in a quart of hot water and give as a drench when cool.

2.

Linseed oil (*alsi ka tel*) or Castor oil (*arindi ka tel*) .	10 ounces.
Sweet oil (*mitha tel*)	10 ounces.
Croton oil (*jamalgota ka tel*)	20 drops.

Mix and give as a drench.

Croton oil should not be given to sheep. May be given as a laxative, by leaving out the croton oil.

STIMULANTS.

3.

Country spirit (*sharab*)	4 ounces.
Powdered ginger (*sonth*)	½ ounce.
Powdered black pepper (*kala mirich*)	2 drams.

Mix and give in a pint of gruel.

Repeat every four hours as long as is necessary.

4.

Sal-ammoniac (*noshadar*)	½ ounce.
Powdered ginger (*sonth*)	½ ounce.
Powdered nux vomica seeds (*kuchla*) . . .	1 dram.

Mix and give in a pint of cold gruel. Repeat every four hours as long as is necessary.

TONIC AND VERMICIDE.

5.

Powdered sulphate of iron (*hira kas*) . . .	½ ounce.
Powdered nux vomica seeds (*kuchla*) . . .	1 dram.
Powdered chiretta (*kiriato*)	1 ounce.

Mix and give one powder in food or in a pint of gruel daily.

ALTERATIVE.

6.

Powdered nitre (*kalmi shora*)	½ ounce.
Powdered sulphur (*gandhak*)	1 ounce.
Powdered ajwan	½ ounce.
Powdered nux vomica seeds (*kuchla*) . . .	1 dram.

Mix and give daily in a pint of gruel.

ASTRINGENT (INTERNAL).

7.

Powdered chalk (*kharya mitti*)	1 ounce.
Powdered catechu (*katha*)	½ ounce.
Powdered ajwan	½ ounce.

Mix and give twice daily in a pint of gruel.

ASTRINGENT AND VERMICIDE.

8.

Powdered sulphate of copper (*nila toothia*) . .	1 dram.
Water	1 pint.

Doses, 1 pint for cattle, one to four ounces for sheep and goats.

ANODYNE OR NARCOTIC.

9.

Powdered opium (*aphim*) or Indian hemp leaves (*bhang*)	3 drams.
Powdered assafœtida (*hing*)	3 drams.
Powdered ginger (*sonth*)	½ ounce.
Country spirit (*sharab*)	4 ounces.

Mix and give in a pint of gruel.

Anodyne and Vermicide.

10.

Turpentine (*tarpin ka tel*)	1 ounce.
Linseed oil (*alsi ka tel*)	1 pint.

Mix and give as a drench.

Vermicide.

11.

Powdered assafœtida (*hing*)	½ ounce.
Powdered sulphur (*gandhak*)	1 ounce.
Powdered palas seeds (*palas*)	1 ounce.

Mix and give a powder daily for ten days in a pint of gruel.

Mouth Gargle.

12.

Powdered borax (*sohaga*) or powdered alum (*phatkari*)	½ ounce.
Water	1 pint.

Dissolve and use as a mouth wash.
Borax lotion may be used as an eye wash.

Skin Disease Dressing.

13.

Powdered sulphur (*gandhak*)	4 ounces.
Rape oil (*karwa tel*)	1 pint.

Mix thoroughly and apply with a brush after washing parts with soap and warm water. Repeat in five days' time after washing again.

14.

Tobacco leaves	1 part.
Water	10 parts.

Boil the tobacco in the water for about half an hour, strain and apply.

Wound Dressing.

15.

Phenyl	1 part.
Water	100 parts.

Useful also for skin disease.

16.

Camphor (*kafur*)	1 part.
Sweet oil (*mitha tel*)	4 parts.

17.

Venice turpentine (*ganda baroza*) . . . . . 1 part.
Sweet oil (*mitha tel*) . . . . 8 parts.

Melt the turpentine in the oil, then strain.

18.

Powdered borax (*sohaga*) . . . . . .
Powdered wood charcoal (*koyala*) . . . .
Powdered alum (*phatkari*) . . . . . .
Powdered sulphate of copper (*nila toothia*) . . .
} equal parts.

Mix into a powder; use as a dry dressing.

Astringent (External).

19.

Powdered sulphate of copper (*nila toothia*) . . . 1 dram.
Powdered sulphate of iron (*hira kas*) . . . . 1 dram.
Powdered alum (*phatkari*) . . . . $\frac{1}{2}$ ounce.
Hot water . . . . 1 pint.

Dissolve and apply when cold. A useful application for arresting bleeding.

Embrocation.

20.

Turpentine (*tarpin ka tel*) . . . . . .
Mustard oil (*rai ka tel*) . . . . . .
} equal parts.

Mix and apply with friction.

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